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TO

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TO

The Madras Agricultural Journal

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Editorial.

New Year Honours. We are extremely glad to note that two of our members are among the recipients of New Year Honours. The title of Rao Bahadur has been conferred on Mr. S. Sundararaman, Government Mycologist, Agricultural Research Institute and on Rao Sahib Y. Ramachandra Rao, Locust Entomologist, Karachi, under the Imperial Council of Agricultural Research.

RAO BAHADUR S. SUNDARARAMAN started service in the Department 30 years ago as assistant to Government Economic Botanist, was later appointed as senior assistant to Dr. McRae, Government Mycologist and he finally succeeded Dr. McRae when the latter left for Pusa. Mycology as a branch of agricultural science had developed but little 30 years ago when Mr. S. Sundararaman started work and he is one of the pioneers in India on the subject. A number of plant diseases of great economic importance have been investigated into, by Mr. S. Sundararaman during his long service. Mr. Sundararaman has been connected with the union ever since its inception and he is now its Vice-President.

RAO BAHADUR Y. RAMACHANDRA RAO like Mr. S. Sundararaman starting service as entomological assistant to Government Botanist worked his way up and was appointed the Madras Entomologist in 1921. During his service in Madras he was for a year put

on special duty as an All-India Officer to investigate the possibilities of finding a biological method of controlling the lantana and we believe this work of his, earned him the title of Rao Sahib. As Entomologist in Coimbatore he was responsible for starting work on biological methods of controlling insect pests. When the locust problem was taken up by the Imperial Council of Agricultural Research, Mr. Ramachandra Rao was selected for the post of Deputy Locust Entomologist and was later appointed as the Locust Entomologist. Mr. Y. Ramachandra Rao is a familiar figure to all members of the Union and during his stay in Coimbatore was one of the active members of the working committee and was for some years Editor of the Journal.

We offer our hearty congratulations to both of them on their well merited distinction. This distinction is a fitting tribute to two branches of science, Mycology and Entomology, the problems of which in their application to agricultural crops, are often complicated and incapable of striking the public imagination like some of the other branches of science.

SIR B. C. BURT. We are glad that knighthood has been conferred on Mr. B. C. Burt, Agricultural Expert and now the Acting Vice-Chairman of the Imperial Council of Agricultural Research. Every one connected with the agricultural departments in India, and who has had a chance of coming in contact with Sir Burt, cannot fail to be impressed with his greatness. He is industry personified and work is a pleasure with him, and there is no activity of the Imperial Council of Agricultural Research where his guiding hand is absent. The success of the Imperial Council of Agricultural Research has been in no small measure due to the ability of Sir Burt who has been its Agricultural Expert from the beginning. While distinguished members of other branches of Science, Botany, Physics, Chemistry, Medicine, Engineering etc. have received this distinction in India already, this is the first time that a member of the Agricultural Service has been chosen for this unique honour. We offer Sir Burt our very hearty congratulations.

Among other recepients of new year honours we are glad to note the names of the following agricultural officers in other provinces.

Khan Bahadur Afzul Hussain, Principal, Agricultural College, Lyallpur, Punjab; Rao Bahadur Tamane, Chief Agricultural Officer, Sindh, and Rai Sahib Lala Harbhajan Lal, Dy. Director of Agriculture, Eastern Circle, Partabgargh.

Ourselves. It is now exactly 25 years since the Madras Agricultural Students' Union was founded, and some of the founders who fortunately are still with us might well feel proud of the developments. The objects of the Union are to encourage an *espirit de crops* among its members and to exchange and record opinions and experiences in matters agricultural. The latter object was sought to be obtained by holding an annual conference and conducting

a journal as an organ of the Union. The journal first published as a year book in 1911, was converted into a quarterly the next year and was made into a monthly in 1915. Apart from the annual conference, the running of the journal is now the one important and sustaining activity of the Union throughout the year. Though in the beginning, the journal was serving a limited purpose, there is no doubt that it has widened its sphere of influence beyond the members of the Union who are all mostly members of the Agricultural Department. The changing of the name of the journal from The Journal of Madras Agricultural Students' Union into The Madras Agricultural Journal has been more than justified.

The main purpose of the Agricultural Department is to impart agricultural knowledge to the public and an agricultural journal like ours naturally supplements the other activities of the Department with regard to the dissemination of such knowledge. It is quite possible that a vernacular journal will be of even greater service because of the very small percentage of people who can read and understand English, but, there is one serious difficulty with regard to the publication of such a journal, namely the existence of four distinct vernaculars, Tamil, Telugu, Malayalam and Canarese in Madras and one cannot easily cater to the needs of the whole province. This is probably one of the reasons why, attempts made to run a vernacular journal in Madras either by private individuals or agencies, have not met with any success. Several of them had to be closed down after a short spell of life. Even agricultural journals in English started by private agencies in India have not succeeded for want of sufficient matter to publish and proper organisations to collect agricultural information. It is therefore a matter for gratification that our journal has run on continuously for the last 24 years.

Our journal is probably the only one of its kind that is run purely by a private organisation of honorary workers, without any financial help from Government or other persons, though of course the editorial board as officers of the Madras Agricultural Department, gets all the facilities and access to the matter that could be published. Since the commencement, each successive board of Editors has been trying to improve the journal by the addition of new features and though there is still scope for further improvements, finance is limiting that scope to a very great extent.

The journal now caters to two sets of people, one the members of the Union who are all officers of the Department, and the other, the enlightened agriculturists of the province. It must be admitted that the requirements of the two sets of people are entirely different. The Union member who is an agricultural officer would like to keep himself in touch with the latest developments of agricultural sciences, and to him, scientific articles appearing in the journal have an appeal. The

practical agriculturists of whom there are a large number of subscribers, desire, on the other hand, popular articles on agricultural matters which might be of some immediate use to them. The attempt to satisfy both the sets of people, has necessarily to be a compromise with the balance perhaps more towards scientific articles. And so far as scientific articles are concerned, we have to pat ourselves on the back, for we believe their standard is appreciated as is seen from the numerous requests we get for copies of special articles from other parts of India and elsewhere. Our articles are also freely quoted in other foreign scientific journals.

The paucity of popular articles has however to be deplored, but we are not without hopes, that this defect will soon be remedied. If only each member of the Union in the district would make up his mind to contribute at least one article a year, about some special crop or some special agricultural practice of the tract he is working in, we should soon have a surfeit of articles which are likely to be understood and appreciated by subscribers who are not officers of the Department. We have on several occasions appealed to our mofussil members and once again at the beginning of the New Year, we appeal for popular contributions from them.

As regards the finances of the journal, it is only recently, that we have just been able to make both ends meet. In the absence of any government grant or private donations the conducting of the journal has to depend upon the number of subscribers on the rolls, and unless the number of subscribers is increased, it would not be possible to make any improvements in the present get up of the journal. Though the strength of the Agricultural Department has been expanding rapidly in recent years, our membership list has unfortunately not gone up to the same extent. There are still a large number of officers who have not enlisted as members. If every member of the Department will enrol, we should have over 1000 subscribers (together with the non-member subscribers), and there should then be no difficulty at all to run the journal. In fact, we should be able to introduce several improvements in its present get up. May we hope that the New Year will bring a greater response to our appeal?

The Union is intending to celebrate in a fitting manner the 25th year of its foundation (Silver Jubilee) this year which also happens to be the 60th year (Diamond Jubilee) of the inauguration of Agricultural Education in the province. There is also a proposal to publish a special number of the journal called the Jubilee Number, and the accomplishment of all these would mean adequate finance. Unfortunately our application to government for financial help has been negatived and we have to depend upon the generosity of the members and well wishers of the Union. An appeal is being sent out by the Secretary of the Union and the amount of response that is obtained will decide the nature of the celebration we are to have this July.

RAINFALL AND YIELD IN THE COCONUT *

By J. S. PATEL, M. Sc. (Cornell)., Ph. D. (Edin).,

Oil Seeds Specialist, Madras Department of Agriculture

and

A. P. ANANDAN, B. A.,

Fieldman to the Oil Seeds Specialist.

Introduction. The yield is the result of the interaction of genetical and environmental factors. The plant-breeder utilizes the genetic variance in evolving superior types ; and the agronomist aids the former in adopting the optimum conditions for the growth of the superior type. One of the important functions of the agronomist is to suggest ways and means to reduce to the minimum the variations in the yields.

The yields of any group of coconuts fluctuate from year to year without any regularity, i. e., there is no periodicity. When the trees receive identical treatment every year, and when the age of the plantation does not influence the yields, the yearly variations in the yield must chiefly be attributed to the weather conditions. A consideration, therefore, of the effect of rainfall on the yield is necessary. In the present communication an attempt is made to show how the yields vary according to the rainfall and how the variations incidental to the rainfall can be reduced to the minimum by suitable changes in the agronomic practices.

Materials and Methods. The data utilized in this paper were collected at the Agricultural Research Station, Kasaragod (District : South Kanara) on the West Coast of India. The soil is red loam. The number of rainy days, and the total rainfall for the different seasons and years, are tabulated in Table I. The yield-data utilized in various correlations was collected from 105 regular bearing palms in Block I. The trees are of the ordinary tall type and they were about twenty-five years old in 1919. The plot has been manured and cultivated more or less in the same manner from year to year. The plot has never been irrigated.

In some of these trees, one or two bunches were damaged by beetles. As this would reduce the yield of the trees, the following correction was applied to the particular year's yield, when any damaged bunch would be ready for harvest. The missing yield is

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* Contribution No. 9 of the Oil Seeds Section of the Madras Department of Agriculture.

$y = \frac{x \times a}{a_1}$ were x is equal to the average for the missing month calculated from the rest of the years, a the average yield per month for the remaining months of the same year, and a_1 the average yield per month for the remaining months of the remaining years.

Wishart and Allen's method could not be used as the number of missing bunches was large (300) and would involve laborious calculations. In working out the relationships, ordinary correlation tables have not been prepared. The yearly yields ranged between 10 and 180 nuts per tree per annum. and, therefore, fine grouping makes the number of class intervals unwieldy. Similarly, for the rainfall, the differences are as low as half an inch and this fact causes the inclusion of two or more years' data exclusively into the same row. It was, therefore, thought better to use the simple product-moment method where the correlation coefficient r is given by the formula:

$$\frac{\Sigma\, d'\, d''}{\sqrt{\Sigma\, d'^2\, d''^2}}$$

As the correlations are worked out in the same manner for all the combinations of the rainfall, the relationships are comparable among themselves. Since, by this method, the effective number of readings dwindles down to 13, which is too inadequate for an analysis of this kind, the relationship between the rain and the yield is considered to be present in cases where r is not less than 0·6; this is enough to lodge the P between 0·02 and 0·01. Before proceeding with the presentation of the data, it must be admitted that the only justification for the departure from the orthodox procedure of dealing with the data spread over a large number of years, is the importance of drawing the attention of the workers to this problem.

Rainfall.—In point of distribution of the rainfall, the coconut areas in India fare very badly when compared to Ceylon and Malaya. On the West Coast, from the middle of December up to the first of April, only a few showers are received. The number of rainy days and the total rainfall for the different seasons and years are tabulated in Table I.

During the south west monsoon very heavy rainfall is received, and the south west monsoon, if at all late, is late only by a few days. The north east monsoon rains are not uniform, but the variations in the early part of the season have very little effect on the yield. That the changes in the quantity of rain received during the south west monsoon and early part of the north east monsoon bear no relation to the yield, is evident from the correlations in Table II, where the value of r is not significant for any of the comparisons. The total rainfall during the calendar year, previous to the year of harvest, does not appear to affect the yield.

Table I.

The Distribution of Rainfall.

Year.	South west monsoon.	North east monsoon.	Hot weather.	Total.	Calendar year.	South west monsoon rains during 1919 *plus* hot weather rains during 1920 for 1921 yields.	North east monsoon *plus* hot weather rains just preceding the year of harvest.	Two hot weather rains previous to the year of harvest.	Total rains during the calendar year.	No. of rainy days. North east.	No. of rainy days. Hot weather.	No. of rainy days. Total.
1919–20	104·14	20·55	10·39	135 08	...	...	...	...	...	...	...	...
1920–21	115·95	10·57	5·43	131·95	...	...	...	...	130·97	35	12	47
1921–22	115·70	12·51	13·79	142 00	1921	109·57	25·98	15 82	141·55	24	22	46
1922-23	104·56	12·17	15·16	131·89	1922	129·74	24·36	19·22	131·89	18	27	45
1923–24	119·75	3·61	4·25	127·61	1923	130·86	27·67	28·95	127·61	24	8	32
1924–25	117·88	3·75	15·28	136·91	1924	108·83	16·42	19·41	136·91	11	23	34
1925–26	101·42	24·56	24·48	150·46	1925	135·03	18·89	19·53	150·33	14	27	41
1926–27	99·64	10·38	1·42	111·44	1926	142 36	28·23	39·76	111·44	32	6	38
1927–28	91·37	16·47	30·78	138·62	1927	102·84	25·98	25 90	138·10	17	22	39
1928–29	86·49	21·85	16·47	124·81	1928	130·42	41·16	32·20	124 81	20	12	32
1929–30	110·53	26·11	23 34	159 98	1929	107·84	32·94	47·25	159 36	25	22	47
1930–31	88·97	23·49	19 41	131 87	1930	109·83	45·19	39 81	131·87	27	21	48
1931–32	117·71	9·38	20·45	147·54	1931	129 94	45·52	42·75	147 54	30	18	48
1932–33	75·18	26·95	25·06	127·19	1932	109·42	43·94	39 86	127·19	30	25	55
1933–34	102·95	20·50	46·80	170·25	1933	142·77	...	...	...	...	...	...

Table II

Coefficient of correlations between the yield and rains of :—	*r*
South west monsoon during the year previous to the year of harvest.	– 0·3004
One north east monsoon rains previous to the year of harvest.	0·1141
South west monsoon in 1919 *plus* hot weather rains, i. e., for 1921 yields.	0 1790
Total rains during the calendar year previous to the year of harvest.	0·5430

The rains received during the south west monsoon are very heavy, and the variations in the rainfall during this period are large enough to mask the effect of other rains when they are combined with the rains received during the south west monsoon. The rainfall during the south west monsoon has, therefore, to be eliminated in determining the relationship between the rainfall and the yield. For the same reasons, the rainfall during the early part of the north east monsoon is also eliminated. The rains which are most likely to affect the trees are those received during the later part of the north east monsoon and during the hot weather. The rains during the hot weather period—January to April—are most irregular (fig. 1). In the following table the important rains are given from 1919 to 1933. In this tabla, x_1 denotes January to May rains of the year of harvest, x_2 January to May rains during the year previous to the harvest, and x_3 January to May rains during the second year previous to harvest.

Table III.

Important Rains.

Years.	January.	February.	March.	April.	Up to 15th May.	After 16th May.	x_1	x_2	x_3	F + M * of x_1, x_2 and x_3.	Average yield per tree per year.
1919	...	...	0·14	0·11	...	5·14	...	...	...	...	...
1920	0·07	...	...	2·86	...	1·07	...	...	...	..	...
1921	0·98	...	...	1·72	2·07	5·13	0·57	2 93	0·25	0 14	61·13
1922	0·45	...	...	2·61	1·79	5·89	5·14	2·70	2 93	...	66·58
1923	...	...	0·45	0·12	0·08	3·18	2·45	3·06	2·70	0·45	58·45
1924	...	...	2·44	2·70	0 03	3·21	0·62	5·57	3·06	2·89	57·88
1925	...	...	1·20	1·25	3·12	13·31	...	5·12	0·57	4·09	60·30
1926	0 13	0·40	...	0·09	...	0·31	...	2·45	5·14	4·04	78·44
1927	...	...	0 03	2·34	...	11·24	...	0·62	2·45	1·63	51·77
1928	0·52	4·72	3·15	...	0·13	0·27	...	2·37	0·62	8·30	70·49
1929	...	...	0·20	5·39	5·40	5·99	...	8·39	2·37	8·10	86 26
1930	0·02	...	...	4·77	10·71	13·50	...	5·59	8 39	7·80	85·29
1931	...	...	0·02	8·36	1·60	7·74	...	4·79	5·59	0·40	73·98
1932	...	...	...	0·42	1·20	22·65	...	8·38	4·79	0·20	62·09
1933	...	...	0·21	6·19	...	19·51	...	0·42	8·38	0·41	60·10
										Mean	67·14

* x_1 stands for total rains in January, February, March and April during the year of harvest. x_2 stands for total rains in the same months during the year previous to harvest. x_3 stands for total rains in the same months during the second year previous to harvest. F and M stand for February and March rains respectively.

Table IV

Correlations of yield with important rainfalls.

(*Note*:—J, F and M stand for January, February and March rains respectively.)

		Value of *r*
1	x_1 = total rains in January, February, March and April during the year of harvest.	0·3400
2	x_2 = total rains in the same months during the year previous to harvest.	0·4598
3	x_3 = total rains in the same months during the second year previous to harvest.	0·3393
4	$(x_1 + x_2)$	0·6428
5	$(x_2 + x_3)$	0·6273
6	$(x_1 + x_2 + x_3)$	0·6767
7	J + F + M of $(x_1 + x_2 + x_3)$	0·7211
8	$(x_2 + x_3)$ + (J + F of x_1)	0·6995
9	J + F + M of x_2 and x_3	0·8104
10	J + F + M of x_2 + (J + F of x_1)	0·5589
11	F + M of (x_1, x_2 and x_3)	0·6656
12	x_2 + (F + M of x_1)	0·4628
13	x_2 + (J + M of x_1)	0·5199
14	J + F + M of x_2 and F + M of x_1	0·4170
15	J + F + M of x_1 and x_2	0·4587
16	J + F + M of x_2 and J + M of x_1	0·3723
17	x_2 + (J + F of x_1)	0·5669
18	April of x_3 + (J + F + M of x_2) (J + F of x_1)	0·3989
19	x up to the 15th May + (J + F of x_1)	0 6409
20	x_2 and x_3 up to the 15th May	0·3391

Note:—All values of *r* above 0·6000 are clearly significant. P is less than 0·02 The differences between these significants are not significant.

In table IV the coefficients of correlations for twenty different combinations of rainfall are tabulated. The magnitude of the r is the largest for the combination (9) —i. e., January to April rains for two years previous to the harvest. The coefficients for seven other combinations are also significant.

The values of the total correlations, viz., ryx_1, ryx_2 and ryx_3 are utilized in finding out the partial correlations (y = yield). The values of the partial correlations are given below:—

Particulars.	Correlation coefficient. Total.	Partial.
$ryx_1 - x_2x_3$	0·3400	0·2769
$ryx_2 - x_3x_1$	0·4598	0·3466
$ryx_3 - x_1x_2$	0·3393	0·2133

For these data partial regression will be more appropriate and therefore the following relationship has been calculated for the deviations of yield y in terms of the deviations of the respective rainfall totals from their means :—

$$y = 2{\cdot}3427x_1 + 3{\cdot}9907x_2 + 0{\cdot}8538x_3$$

A multiple correlation where $R = 0{\cdot}798$ was also obtained. The multiple correlation value is very close to the coefficient of correlation for the total rains in three years during January to April. The total as well as the partial correlations are not significant, thereby, indicating that the rainfall of one year is not related to the rainfall of another year for the observations made, and that total correlations, wherever significant, are not spurious.

Significance of the partial regression coefficients.

Regression coefficient.	Value of b.	Value of P.
b_1	$2{\cdot}3407 \pm 0{\cdot}84$	$< 0{\cdot}02$
b_2	$3{\cdot}9907 \pm 1{\cdot}01$	$< 0{\cdot}01$
b_3	$0{\cdot}8538 \pm 0{\cdot}78$	$> 0{\cdot}90$

The regression coefficients, given above, show that the rainfall of the year previous to the year of the harvest are significantly correlated to the yield. Though the regression coefficient, for the rainfall of the second year previous to the harvest, is not significant, the importance of this rainfall is derived from the fact that multiple correlation is significant.

Variance due to	Degrees of freedom.	Sum of squares.	Mean square.	Z
Linear regression	3	907·30	302 43	
Deviation from linear regression.	9	542·89	60·32	
Total.	12	1450·19		0·8059

The figures given above show a slightly significant deviation from linear regression, indicating that the curve of the relationship between

the rainfall and the yield does not follow a straight line. The points appear to be distributed along a parabola.

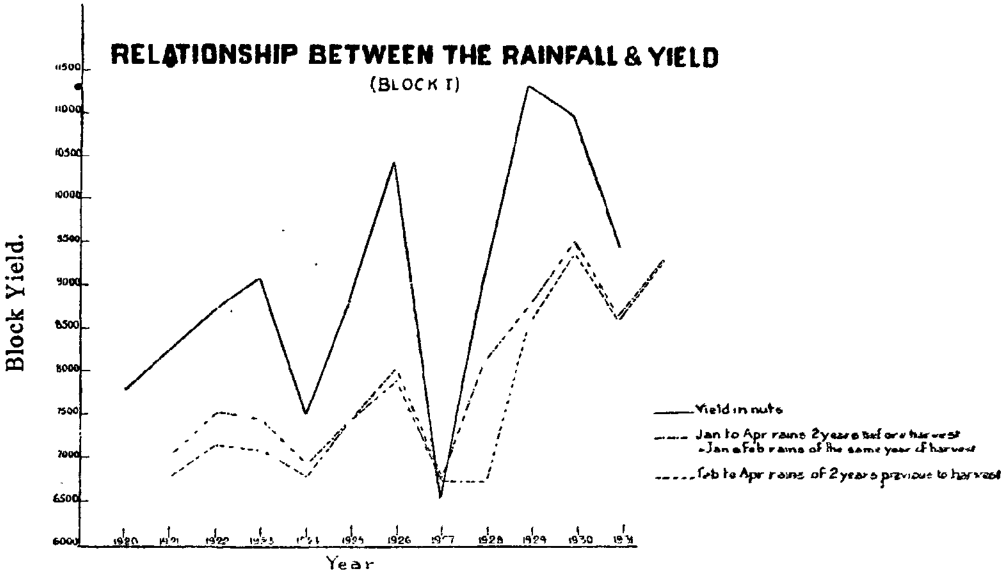
A second degree function of the closest fit of parabola has been calculated by the least square method for the combinations of the rains which give highly significant values of r. The details regarding the equation of the parabola of the closest fit are given below:—

Particulars of rains.	Equation of parabola.
(1) x_2	$y=54{\cdot}489+5{\cdot}227x-0{\cdot}3x^2$
(2) x_3+x_2 + January and February rains of the year of harvest.	$y=44{\cdot}795+4{\cdot}336x-0{\cdot}149x^2$
(3) January, February and March rains of (x_2 and x_3)	$y=57{\cdot}2+4{\cdot}521x-0{\cdot}13x^2$
(4) January, February and March rains of ($x_1+x_2+x_3$)	$y=56{\cdot}556+3{\cdot}564x-0\ 098x^2$
(5) $x_1+x_2+x_3$	$y=44{\cdot}5+1{\cdot}734x-0{\cdot}009x^2$
(6) February and March rains of $x_1+x_2+x_3$	$y=63{\cdot}658-1{\cdot}795+0{\cdot}48x^2$

In all the above equations, y denotes the yield in nuts per tree and x represents the quantity of rain in inches during the respective periods. All the equations show, as expected, that the yield does not go below a certain minimum even if x becomes zero. The minimum yield that can be expected, per tree, even if January to April rains for the two years prior to harvest and for the year of the harvest are nil, is about 44 nuts per tree.

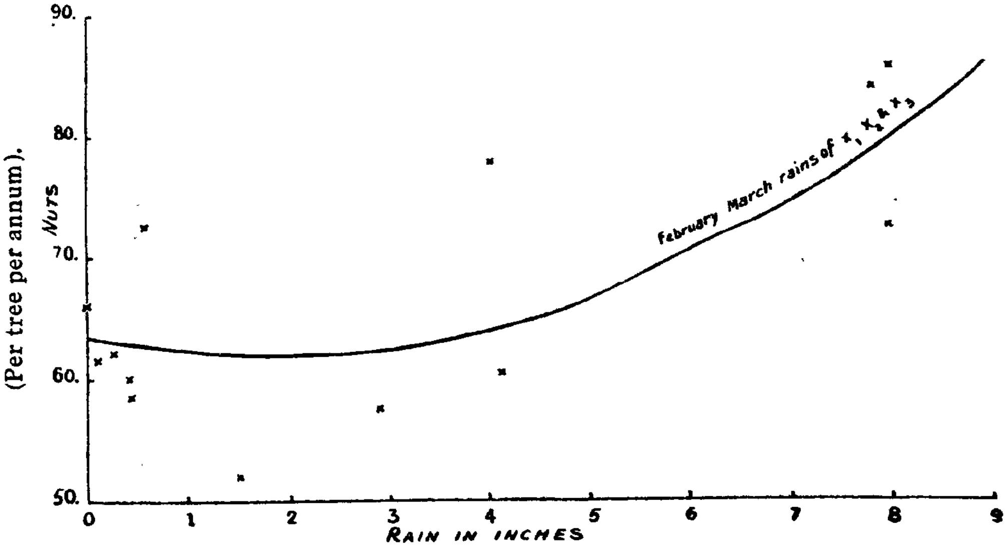
From Table III, it is evident that none of the combinations of rains—the total amount of rainfall – explain the yield during the two years 1926 and 1932. Contrary to expectations, the deviations of the yields from the mean are, for these two years, opposite in sign to the corresponding deviations of the rains for the mean. The rains which relate to 1926 yield, *i. e.*, those of 1925 are below the mean, while the yield is well above the mean. The position during 1932 is just the reverse. These two, out of 13 readings, cannot be attributed to chance, but they may be more appropriately termed abnormal readings.

The year 1925 which is responsible for the yield during 1926, had uniform rainfall during March and April and there had also been continuous light showers from the middle of April to the out-break of the south west monsoon. The year, therefore, experienced the least amount of drought. The poor yield in 1932 is due to the extreme long spell of dry weather, from December 1930 to the end of March 1931. The highest yield is obtained in 1929, on account of heavy rainfall amounting to 7·87 inches during February to March.



GRAPH I

GRAPH II



In all the equations, excepting the last, the coefficient of x^2 is negative (with due regard to the inadequate size of the data) showing that yield cannot go on increasing with the rains. Even though the totals of two or more different rainfalls have been combined in some of the groupings, the mathematical representations obtained therefrom may be taken to show the existence of a relationship, if not the actual extent thereof. The sixth equation, which shows the relation of February-March rains to yields is unique in that the coefficient of x^2 is positive and that of x negative. Since there is no limit to the positive, theoretical value of the ordinate of the curve, it is to be understood that there is a limit to the quantity of rainfall which can be expected during the months of February and March; but a large quantity of rain invariably increases the yield. The high value for c (63·58) of this equation should safely be taken to mean that rains during the other months of the year increase the yield up to a certain period. The negative coefficient of x indicates that the yield is adversely affected by a small amount of rain in February and March; but the value of y rises when x is more than that particular value. Since $y = 0·96\,x - 1·795$ is the equation of the gradient of the provisional curve of the sixth equation, it means that the yield is minimum when x (the rainfall) is 1·85 inches. It may, therefore, be inferred that a substantial amount of rainfall, *i. e.*, more than 1·85 inches during February to March is important.

The observed and expected value of yield for the sixth equation are shown in graph II.

Rainfall and intercultivation. It is pertinent for a planter to question as to how the variations in the yield consequent to the fluctuations in the rainfall can be avoided or reduced. For the localities where the gardens cannot be irrigated, the intercultivation reduces considerably the annual variations in the yields.

A plot has been left uncultivated since 1916. The weeds are not removed and the palms grow almost in a wild state except that they are not as crowded up as they would be in nature. In another plot intercultivation has been practised since 1916. The land in this plot is ploughed two to three times in the year and occasionally cultivated with Guntaka or the showel cultivator to keep off the weeds. None of the plots were manured. In the following table the annual yields for these two treatments, viz, uncultivated and intercultivated, are recorded.

Table V. *Yield and interculitvation.*

Years.	Average number of nuts per tree per annum.	
	Uncultivated.	Intercultivated.
1917	4·0	14·4
1918	8·3	23·5
1919	6·4	44·4
1920	1 7	46·3
1921	1 6	54·5
1922	13·1	59·3
1923	11·7	56·4
1924	7·4	46·0
1925	2 7	48·4
1926	11·6	65·6
1927	2·4	30·4
1928	2·3	59 1
1929	12·6	58·1
1930	0·3	59·1
1931	1·7	45·3
1932	4·6	47·9
1933	11·0	46·1
1934	3·8	37·1
Average per year—1917 and 1918	6·2	19·0
Average per year—1919 to 1934	5·9	50 3
Percentage increase in the average of 1919 to 1934 over the average of 1917 to 1918	- 4·8	164·7

The yield in the cultivated plot has increased suddenly in 1919 by 134 per cent. of the average of 1917-18. The increase in the yield after 1919 has been gradual. Annual variations in the yields of the cultivated plot are very low when compared with those of the plot left uncultivated. The coefficient of variability for the cultivated plot is 16·6 per cent., but for the uncultivated plot it is as much as 76·2 per cent. The cultivated plot is decidedly less subject to the seasonal conditions than the uncultivated plot. Intercultivation is, therefore, one of the methods to be utilized in regulating the production.

Discussion:—The study has pointed out that yield in any particular year is influenced by January to April rains for two years previous to the harvest, together with the rains in January to April of the year of harvest. To understand, how the rains during the three years affect the yield, a knowledge of the coconut crown is necessary. The details regarding the crown of a bearing tree as observed in January 1934, are given below:—

Leaf No.	When the inflorescence will be harvested.	The condition of the inflorescence.
10	January 1934	Not ready for harvest
18	September 1934	Tender nuts four months old.
22	January 1935	Spadix just opened.
32	November 1935	The last opened leaf. The spathe will open in about ten months.
34	January 1936	Unopened leaf. The spathe will open in January 1935.
45	December 1936	Unopened leaf. The spathe will open in December 1935.

On the dissection of the crown, it is found that in the axils of leaves, 23 to 45 there are developing spadices, at various stages of the growth. The rains during January 1934, would, therefore, affect these developing spadices, which would come up for harvest during 1935 and 1936. It would also affect the shedding of buttons from the spadix which opened during January 1934. In a similar manner, the rainfall in each of the months during 1934 would affect the setting of the crop to be harvested in 1935. Thus the rainfall during 1934 would affect the yields in 1934, 1935 and 1936.

The development of the inflorescence is a slow process taking about thirty-four months from the time of the differentiation of the flower primordium to the opening of the spathe. The maximum elongation of the spathe occurs during the period of six months prior to the opening of the spathe. The branches of the inflorescence begin to form about sixteen months prior to the opening of the spathe; and severe drought occuring at this period kills the growing points and the spathe aborts. Park (1934) has found that the drought affected the yields for a period of about thirty-two months after the commencement of drought. Thus there is support for the view that the effect of rainfall lasts for about three years after the incidence of the rainfall.

Park (1934) found that severe drought experienced in Puttalam (Ceylon) in 1931, decreased the copra per nut production for a period of one year with the maximum effect approximately six months after the drought. Shepherd's (1926) investigations, in Trinidad, have revealed a positive and significant correlation of $0{\cdot}733 \pm 0{\cdot}072$ between the rainfall over a six month period and the size of the nut one year later. The findings of Shepherd, and Park are in agreement since the size of the nut and copra per nut production are correlated. Patel (1934) has found that the size of the nut and its copra content are correlated. He found the following coefficients of correlations:—

(i) Between the volume of the unhusked nut and its yield of copra $0{\cdot}659 \pm 0{\cdot}013$,

(ii) Between the volume of the husked nut and its yield of copra $0{\cdot}680 \pm 0{\cdot}0127$.

The authors have, however, not attempted the study of the effect of rainfall on the size of the nut or on the yield of copra per nut. From the point of view of the practical agriculturists, the most important finding is the utility in minimizing considerably the effect of rainfall on yield.

Summary and conclusions. The study has pointed out that yield in any particular year is influenced by January to April rains for two years previous to harvest, together with the rains in January to April of the year of harvest. The study of the crown has shown how the rainfall in a particular year affects the yields during that year and the

succeeding two years. On the West Coast of India, the critical rains are those which are received during January to April. Annual variations in the yields of nuts are much more for the uncultivated plot than for the cultivated plot. The vagaries of seasons have less effect on the trees in a cultivated garden, than on those in a plot left uncultivated.

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MULTIPLE SEEDEDNESS IN SORGHUM AND CONSEQUENT REPERCUSSIONS

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The occurrence of double seeds in cereals is frequently reported. The presence of double seedeed varieties in sorghum is on record. In a previous article (G. N. R. Ayyangar and M. A. S. Ayyar, 1929)[1] the stray occurrence of double seeds in a variety of sorghum (*S. Roxb* var *hians.*) has been reported and the possibility of accentuating this double grained condition by continued selection over a period of years indicated. Such selection work was done but resulted in no appreciable increase in doubleness. The range of occurrence proved to be of about the same degree of fluctuation.

While this selection work was in progress further fresh material was obtained from various sources and led to a detailed and careful examination of this doubleness. The material represents varieties from Madras, Central Provinces, and Bihar in India and Nigeria, Rhodesia and Tanganyika in Africa. The incidence of doubleness varied according to the variety. This variation was from head to head in the variety and in the incidence within the earhead. In six varieties (mostly *S. Durra*) all the earheads produced double grains. In the others the incidence was from 1 to 70 per cent of the population. This wide range of material from the various parts of the world representing varying degrees of manifestation of doubleness afforded very good material for the study of this character.

In M. S. 2556, a variety from Nigeria, an analysis of a typical earhead showed that out of the 490 spikelets, 89 were single seeded, 387 double seeded and 14 triple seeded. The double seeded were 79 per cent and the triple seeded 2·8 per cent of the total number of spikelets. In A. S. 3618, a pure line selected from a Bihar variety, the incidence of triple seeded spikelets in an earhead was as much as 36 per cent. This accentuation in tripleness resulted in the production in the same earhead of 81 four-seeded, 14 five-seeded and 3 six-seeded spikelets representing 7·7, 1·3 and 0·3 per cent respectively of the total number of spikelets. This occurrence of 4, 5, and 6 seeded condition in the same spikelet (Fig. 1) is the first on record in sorghum. The incidence of six seeded-ness is 0·3 per cent, a considerable excess over the 0·23 per cent incidence of tripleness recorded by Karper (1931)[2].

This tendency to multiply the seeds finds its commonest expression in doubling. The North Indian name, *Dho-Dhanya*—Two Grains—is connotative of this frequent occurrence. Before the details of this doubling are gone into, the structure of a grain-bearing sorghum spikelet may be given. The two outer glumes of the spikelet are leathery. The two inner glumes are hyaline. The inner-most glume (hyaline) has a palea and between these two are the floral parts producing the seed. It is this fourth grain-bearing glume that bears an awn. The inner glumes, as has already been mentioned, are hyaline and any protection to the growing grain is afforded by the outer leathery glumes that are behind these hyaline ones. When the fourth glume bears a grain between it and its thin palea, the grain develops with the embryo towards the side of its glume, the development of the endosperm being towards the palea and therefore towards the third hyaline glume and the first leathery one behind it.

This free development of the endosperm towards one side leaves the grain asymmetrical with reference to the embryo. Another effect of this glumal equipment is the flat disposition of the growing endosperm which the resistance of the leathery glumes impose on it.

The first type of doubling and the commonest is when the third glume which is hyaline bears a grain in its axil subtended by a new palea which it develops to enclose this second grain. As in the case of the first grain the embryo is towards its glume and the endospermal development towards its palea, with the inevitable result that in this common type of doubling, the two embryos are away from each other, one each towards the outer leathery glumes. This opposite disposition of the embryos is therefore much more simple of explanation than in terms of "inversion" (Karper)[2].

The endosperms of both the grains are flattish and the flatness of disposition is in a plane parallel to the glumes. This abnormal development in an otherwise abortive glume leads to the natural result of

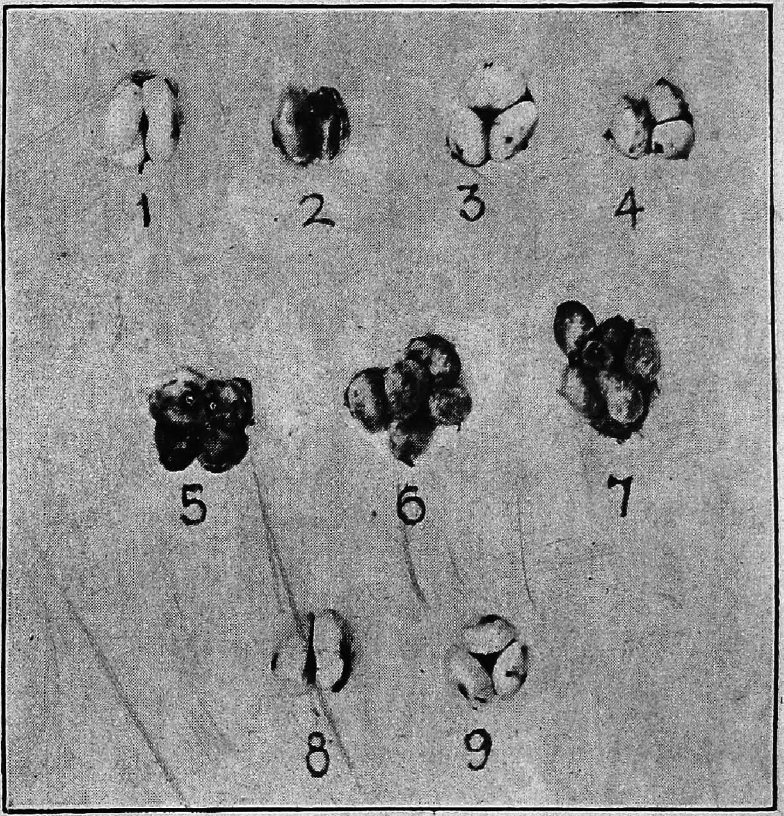

Fig. 1.

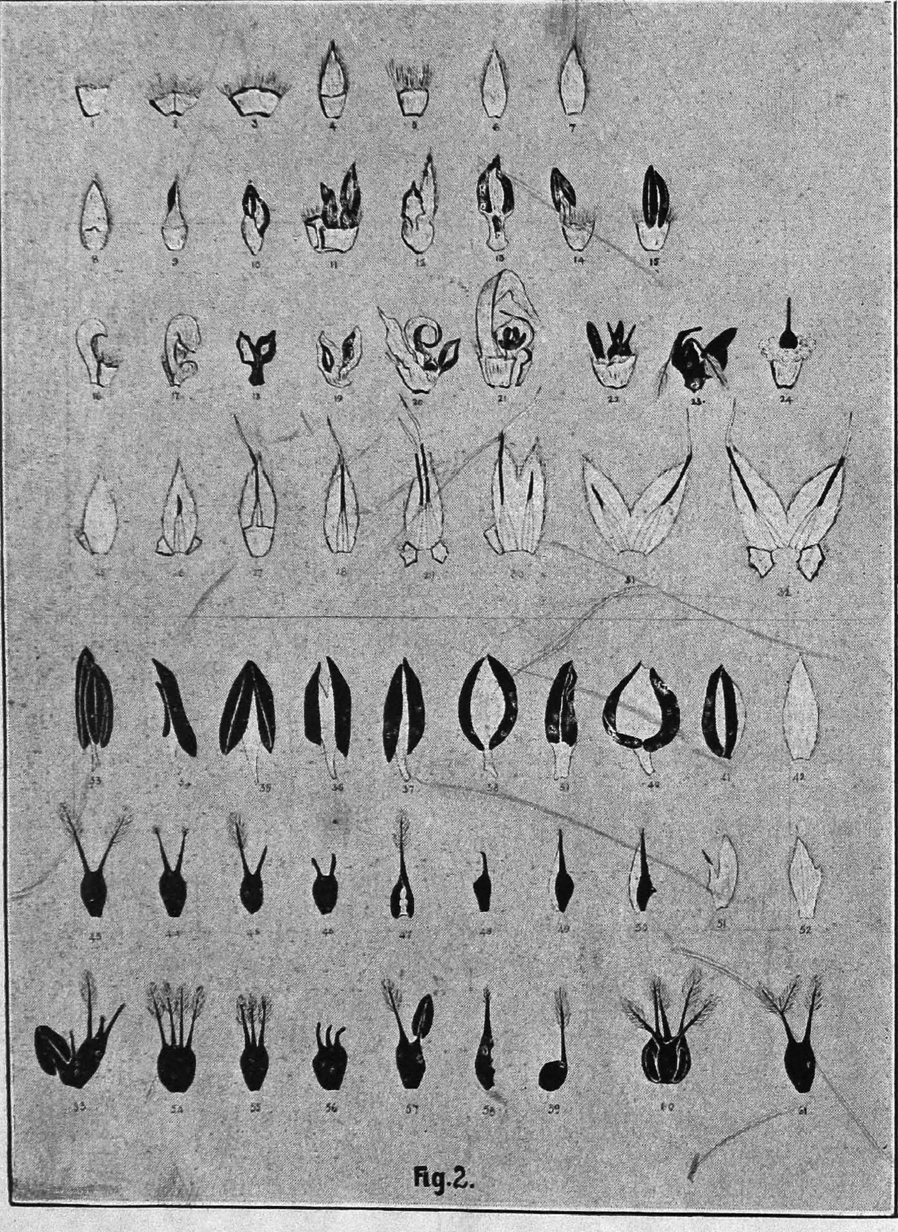

Fig.2.

one of the pair—the new one—being a bit smaller (Fig. I, 2) than the other—the usual one. The two leathery glumes are a protection to the flowers and the growing grain. The two inner glumes could alone bear grains in their axils—so much so that this type of fertility and the double seeds that result therefrom can be double and no more. The "primordia of a third flower" (Karper)[2] have not been met with. From tripling to six-seeded-ness having been met with, the causes for the phenomena are otherwise than this basic fertility of these inner glumes.

A second type of doubleness is the one that results in usually two and occasionally three seeds within a lemma. (Fig. I, 1, 8), The seeds resulting therefrom fall under the group of connate, and Siamese twin group. This doubling occurs within a lemma and involves no excess floral envelopes. There are two embryos. The endosperm developes in support of each of these two. This double development is not easy towards the leathery glumes. The two halves of connate grain therefore grow out and fill the V-shaped interstices formed by the glumes forced apart. This type of doubling and the free development of endospermal growth on two sides instead of one, leaves the double grain, taken as a unit, symmetrical with reference to the two embryos and the two endosperms, each half being as usual, asymmetrical by itself. Such a disposition of the embryo and its endosperm in doubleness will automatically leave the embryos adjacent to each other. The very nature of this doubling is such that no marked inequalities can exist between the two halves. An accentuation of this type of doubling can lead to triplets in the same lemma (Fig. I, 3 & 9). When triplets occur, their embryos are likewise at the centre and near each other.

The above two types of doubling may occur either alone or together in one and the same spikelet. When they occur together it is the normal grain in the fourth glume that turns connate, leaving the newly activated third glume usually single. This leads to triplets, (Fig. I, 4). Occasionally the grain in the third glume may also turn connate. This results in quadruple seeds (Fig. I, 5). Other degrees of intensity in manifolding, representing a combination of these dual lines of doubling result in the extreme cases of six and five grains (Fig. I, 6 & 7).

This prolificness is also reflected in the pedicelled spikelets which are occasionally antheriferous. An examination of a number of spikelets in *Dho-Dhanya* showed that even in these pedicelled spikelets the third glume bore anthers, only these tended to be a bit smallish in size. The pollen in these anthers was normal. There were two lodicules and a palea. In most cases there were only two anthers, the third one proliferating.

This proliferation in grains led to a close examination of the incidental floral accompaniments. Several abnormalities have been met with and most of these have been connected with the newly activated flower in the third glume. The normal equipment per flower are the usual single ovary, three stamens, two lodicules and two stigmas. The intense proliferation, firstly by the activation of the third glume into fertility and secondly by each of these centres of fertility proliferating into connateness sometimes of a triple degree, created conditions so chronically different to the usual, that the normal ratio between the number of grains and the attendant floral accompaniments got seriously upset. This led to metamorphoses of types tending to throw intense light on the fundamental trimerousness of the grass flower. Three lodicules and 3 to 5 stigmas have been met with. Six stamens in entirety did not occur. This trimery is and could never be met with in perfection but all the rudimentary stages indicative of this have been experienced. Most of the aspects are naturally abnormal. The stages by which the metamorphosis of floral parts have occurred are in Fig. II.

A series by which the ciliate, fleshy lodicule turns into a parchment-like ciliate lemma is pictured in Fig. II, 1–7. The stages through which a lodicule gets metamorphosed into a stamen are presented in sketches 8–15. A lodicule turning through various incipient stages into an additional flower is pictured in sketches 16–24. The lodicule turning into a lemma with an awn, (the sole vestige of a glume that could be fertile) is portrayed in 25–32. The transitions between an anther and a lemma are figured in 33–42. Similarly, between an ovary and a lemma in 43–52. The abnormalities in stigmatic doubling are given in 53–61.

These multifloral tendencies leading to an elaboration of the floral parts in a unifloral type are of intense evolutionary interest. They amply bear out the hexamerous condition of the Grass Flower and lend weight to Saunders' (1925)[3] interpretation thereof.

This double seeded-ness having been met with in a constancy of manifestation, crosses have been made with single seeded varieties. The first generation plants were double seeded and further generations are keenly looked forward to.

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FRUIT MARKETING IN MADRAS PRESIDENCY WITH SPECIAL REFERENCE TO ORANGES*

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The total area under fruits and vegetables including root crops in the Presidency is about ·7 million acres. Roughly a little over a third of this area, is under mangoes and about 20% under plantains; only about 15,000 acres are under citrus fruits.

Most of the plantains produced in our Presidency find a sale in the local shandies. The quantity that moves by rail to markets in cities and large towns, is of the order of about 8½ lakhs of railway maunds for the southern districts, of which, Madras City alone consumes more than a third. During the past few years, we are faced with the difficulty of finding proper markets for plantains, and, the possibilities of finding markets outside the province have had to be examined. In this connection, the Agricultural Department has been considering the development of export trade to North India, and with the co-operation of the railways has been able to obtain special rates for through wagons to certain cities in the north. Questions like quick transport, the provision of special wagons suitable for fruit traffic etc., are engaging attention. With the grant made by the Imperial Council of Agricultural Research intensive research work on plantain has been proposed to be taken up in Coimbatore and other plantain growing areas.

Although our position in respect of production of plantains is satisfactory, it is hardly so with other fruits. With regard to grapes, for example, we are importing heavily from Northern India to the tune of four thousand maunds, while our consumption of apples, which also runs to about the same quantity, is practically met from supplies from outside the province, as also from outside India like Japan, Africa and America. We have also no production worthy of the name in the case of plums, peaches and similar classes of choice fruits. Madras imports annually, plums to the extent of 800 maunds mainly from Mirzapore, and also from South Africa. All these facts are enough to show that in the matter of fruits there is a wide market, even in our own province, for expansion.

Let us now consider about oranges with which we are more concerned today. Although the area under citrus fruits is of the order of 15,000 acres, the acreage under oranges is limited to certain districts as follows :--

Sathugudi Oranges ... Ceded Districts, Chittoor and North Arcot.

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* A lecture delivered on the occasion of the opening of the Fruit Research Station at Anantarajpet on the 12th December 1935 by the Hon'ble Mr. P. T. Rajan.

Coorg Oranges or Kamala (Loose Jacket)	...	Nilgiris, Salem, Madura, Vizagapatam and Godavari.
Salem (Tight Jacket)	...	Salem and Nilgiris in parts.
Batavin ...	...	West Godavari and Kistna.
Sour Oranges ...	...	Guntur, Kistna and Godavari.
Mozambique ...	...	Parts of Ceded Districts.

Besides these home-grown varieties, Madras imports largely from Nagpur, and smaller shipments from South Africa, Australia and America. Taking the case of Madras City, which is the largest consuming centre in the Presidency for oranges, the supplies during 1934–35 have been as follows:—

Nagpur Oranges	...	37,360	Railway maunds.
Sathgudi Oranges	...	35,000	" "
Batavian (mainly)	...	7,000	" "
Salem Oranges	...	4.000	" "
South African Oranges	...	400	" "

We have not yet received full figures from certain places, but from the figures already quoted, the supply of Madras is of the order of 90,000 maunds of which Nagpur oranges alone contribute about 45%. These oranges have also found good markets in the south of the Presidency in places like Trichinopoly, Madura and Coimbatore. The last mentioned place alone is reported to consume 50,000 rupees worth of Nagpur oranges every year. Besides Nagpur oranges, the above three districts receive supplies from Coorg through the assembling market at Tellicherry. Even four to five lorry loads of 15,000 fruits each per day are consumed in the season from December to March. I have taken the imports first, as they are broadly indicative of our deficiencies, and therefore of our market avenues.

Let us next take the case of our home production. The *Sathgudi* oranges find a market largely in Madras City. They are very popular in Madras and fetch better prices than any other variety. Oranges from the Nilgiris are consumed largely in Coimbatore, Salem and Trichinopoly districts and to a small extent in Madras. The Salem orange finds a market in Madras and Coimbatore, but what is known as '*Cheeni*' in that variety is of the tight jacket type and very sour. It is a cheap orange and arrives early in the season, at a time when other oranges are scarce, and therefore finds a ready market. The loose jacket or *kamala* of the Circars finds a sale in the districts of production. It also moves to Madras, but the quantity is small as compared to Nagpur or *Sathgudi* oranges. The Batavians however are most popular in their own tract, and have not found extensive markets outside. They move in small quantities to Madras, Nizam's State, Karagpur and Vizianagram. Lastly, we have the sour oranges of Guntur which, on account of the dietetic value ascribed, have established a strong local reputation and are mostly consumed in the producing area.

I have so far given a broad indication of the movements of the trade in oranges in our presidency, but what we are more really concerned with is the direction of quality and movements in order to best make use of the supplies, to meet the demand. In considering this problem, we have to consider several points like the competition between different fruits, varieties of the same fruits, seasons of glut and scarcity, fluctuation in prices and lastly variations in the quality as well as quantity of demand. I am not going to enter into minute details here which will form the subject of a comprehensive survey we are now making of the fruit trade. But as a general indication of the tendencies involved and of the line of action to be adopted, I shall cite as an example the case of the Madras City, which as I have told you consumes annually about a lakh maunds of oranges from all sources. Taking the year 1934–35, it is found that the supply of oranges is limited in the months of June–July, being only about one thousand maunds in each case. This supply increases to 6,000 maunds in August, and 9,000 maunds in September. Up to this point, the contribution is almost entirely from the Sathgudi oranges, with very little competition from other sources. It is on this account that this variety fetches very good prices at that time, the prices being so high as Rs. 2–8–0 per dozen for the best grades, and about a rupee for the smaller sorts.

But in the months of October–November the loose jacket or *kamala* from the Circars reaches the Madras Market. The first stage of competition begins now and wholesale prices fall from Rs. 10 to Rs. 5 per hundred, for the top grade of *Sathgudi*. This fall in prices continues until January, and supplies amount from eight to ten thousand maunds per month. From January onwards competition of a different kind is introduced with the onset of Nagpur oranges. In December they arrive in small consignments, but from January onwards they are consigned in special wagons attached to passenger trains from Nagpur or Katol, each wagon carrying 1,200 to 1,500 baskets of fruits. Altogether 80 such wagons arrived during last season, the period of peak being in February–March. From March onwards, the supply of Nagpur oranges goes down, the quantity in May being only 5,000 maunds, and still less in June–July.

I have given you a broad idea of the supply and demand of Madras City, which is the largest market for oranges in the province, as an indication of the market conditions during the year. The practical consideration that should guide us in laying down any policy of future programme, consists essentially in making the best use of the supplies to meet the demand. As already indicated in my figures, there is a deficit supply of oranges in the city in the months of May, June and July and a glut in December to March. It is this variation that is responsible for the large fluctuation in prices that occurs in the same season in the fruit market. But with proper marketing such variations

should be reduced to a minimum. The chief aim is to ensure a stability of supply and fair prices in the trade, to benefit the consumer as well as the general trade. In order to ensure this, two things can be done; the first is the exploitation of new markets during glut and the second the prolongation of the marketing period by methods such as cold storage, to get a more evenly distributed supply.

I shall deal with the problem of gluts first. In the season, the Madras market gets over-full, the commission agents dispose of their stock to their customers at Trichinopoly, Madura, Tanjore and Salem districts. Direct marketing to these centres is done in the case of Nagpur oranges by agents who settle there in the season. For the home produce a first improvement can be effected by greater direct booking to the centres, avoiding by that means a glut in Madras. This will also ensure a greater uniformity of supply to the consuming areas. At present, Salem oranges move to towns in the south like Tanjore and Mayavaram, but the demand for other varieties also exists. From our studies, we find that a demand for superior varieties and better quality exists in the centres at Coimbatore, Trichinopoly, Madura and Tanjore. Similarly the West Coast can take in better varieties like the Sathgudi in place of the commoner quality largely used now. The "Eat more fruit" campaign in England has contributed largely to increase consumption, and there is no reason why similar results should not be achieved elsewhere. Already thanks to the high value attached to fruits by the medical profession and by nutrition experts people are taking more and more to fruit diet especially oranges.

This leads us as a next step to the improvement in varieties which is a natural essential for market expansion. There is much scope for work in this connection. Many of the gardens in certain districts are not properly cared for, and in these are grown sour oranges instead of the better varieties. Trees are grown in shade, no attempt at pruning or cultivation is made, and the plantation lives a hand to mouth existence. It is in this aspect of the problem that the fruit research station, which is being established under such good auspices, will open out possibilities. Our province has also yet to develop greater experiences in the use of citrus graft through adaptability to different conditions and also the bearing of stock on scion. In this direction also will this fruit research station contribute to our future. Introduction of finer varieties like the Washington-Navel orange, to suit the demand from special consumers, and research in the methods of pruning, manuring and cultivation will also go side by side. At Coonoor, inarching has met with greater success than budding, but in the Batavian tract greater success at budding has been reported to have been achieved by some growers.

Let us now consider the methods of organisation necessary to develop marketing. A common feature of our existing conditions is

the wide gap between the prices paid to the grower and that paid by the consumer. In America and Africa this spread between the growers' and consumers' prices has been sought to be remedied by the creation of marketing organizations which have developed enormously in these days. The assembling and grading of fruit, packing, provision of cold storage, inspection at ports of consignment and delivery are all done by these associations. Fruits travel several thousand miles on land and sea, and have found markets all over the world. The Co-operative Organisation of the Californian Fruit Growers handles more than ten million dollars worth of fruit every year. The local associations do business up-to a lakh of dollars each. The work is carried on by a central exchange with district branches. So far as *Kodur* oranges are concerned it is a well known fact that there are more than two or three intermediaries before the fruits reach the consumer viz., the contractor or the lessee of the garden, commission agents and godown owners in Madras, the wholesaler, retailer etc. If an Association of fruit growers of this area be formed and arrangements made for the establishment of sale agencies in Madras and other principal centres in the Presidency, it should be possible to realise better returns than now. The aims and objects of such an Association will be:—

1. To organise the marketing of fruit on a co-operative basis by adopting the improved methods in grading, packing etc., and by establishing sale agencies wherever found necessary in order that the growers may secure better value for their produce.

2. To finance the growers, so that, if necessary, they may pledge their crop to the Association and not to contractors who now lease out their gardens at a low rate in the early stages of growth of the fruit.

3. To obtain necessary requisites such as seeds, plants, manures, implements etc., on a wholesale basis and to supply these to the garden owners as cheaply as possible.

4. To arrange for careful handling and rapid transport of the fruit on Railways and to secure reasonable and concession rates.

5. To supply the services of specially selected *maistries* to assist growers to lay out or extend their gardens and renovate old ones, to bud, prune etc.

6. To organize fruit shows so as to stimulate better production, grading, packing and marketing.

7. To issue to members free of charge, posters, leaflets etc. containing information about seasonal operations, prices and other marketing news.

8. Generally to take such steps as would encourage fruit growing within the district by obtaining all possible assistance and support from Government and public bodies.

In a work of this kind, however, our country has much to learn. The first point to remember is that of grading and standardisation of fruits. The existence of standard grades is a common medium of understanding between grower and consumer and between buyer and seller, even when separated by long distance. It also makes for a steady market and an assured supply of what is wanted. If we look at any package of the South African or American fruit for example, what we find is that all the fruits are of one size, of guaranteed variety and free from blemishes. The consumer, and specially the better class of consumer, is prepared to pay for this. Gradually the existence of grades will also fix the nature of demand and result in less delay in transport in reaching suitable destinations. At present, sorting of fruits is done in a small way by the wholesale commission agents at Madras and again at the retail market. It is on this question that growers have to improve themselves most. The marketing survey now in progress is engaged in the fixing of standard grades on an all-India basis suitable for more efficient trade, and with the growth of healthy organisation this part of the work is bound to expand considerably.

The ultimate aim of marketing organisations will be to reduce costs at all stages of marketing while providing for large increases in the trade. The pooling of produce is at present largely done by contractors at the wholesalers' godowns in Madras but we have often had reports that full amounts have not been paid. A healthy system of marketing finance from growers' organisations, has been a very useful remedy in this connection, but in a perishable commodity like fruit, a certain amount of care is indicated. A necessary condition for such organisation is that they should represent a large body of the growers. Otherwise success cannot be achieved. It is only in recent years that we are seeing attempts at such organisation, but greater effort is needed to make them serviceable. I need hardly add that the marketing section will render all possible help to foster the growth of such associations. It is by no means to be inferred from this that the services of middlemen will be entirely dispensed with, but costs can be reduced considerably, while periods of gluts and depression can be more adequately dealt with.

As a necessary accompaniment to work of development must be mentioned the development of technique in the methods of grading, packing and storage. I have already indicated the advantages of standardised grades, but the question of next importance is that of storage. Countries like Africa and America that have established a

wide export trade have arranged for a systematic erection of cold storage plants to fit in with assembling centres. In our own country, the Bombay department have conducted trials on the cold storage of mangoes. The findings are that while Alphonso and Salem varieties respond well to treatment, the Circars variety '*Swarnareka*' does not. It is said that the storage life of fruits can be extended by even about 60 days by proper cold storage methods. The economic advantages of this are obvious. For instance, I have already pointed out that there is a deficiency of supply in June–July. If the glut of April could be preserved in cold storage up to May–June, there will not only be a more even supply but better prices could be got. Also fruits imported from abroad, which are transported under cold storage, require cold temperature during keeping at ports, and the erection of cold plants will therefore be advantageous.

In considering the necessity for cold storage plants it is well to remember that the methods for pre-cooled plants on the field are different from those adopted for fruits which have already been handled in transport. Internal breakdown is more difficult to avoid in the latter case. The special conditions necessary for such work in India are to be fully studied, but it is a necessary condition for long distance transport and for export trade. There are wide markets for citrus fruits as in England which imports annually from two and a half to three lakhs of tons of oranges every year, but such considerations though not immediately indicated, should be borne in mind in our developmental work for the future.

There is also another method by which gluts in the market can be avoided, and that is by the fruit preserving and transforming industry. The Bangalore Institute reports favourably on the vitamin content of some of our citrus fruits, and results obtained in North India point to considerable success in this direction. Fruits can be preserved with and without sugar, under particular conditions, but the need for such work is indicated only in case of gluts or over-production as for instance in the case of pears in the Nilgiris or limes in certain parts of the Presidency. As for oranges there appears sufficient demand at present for fresh fruits although some centres as in the Nilgiris and Salem are not finding the full market. I daresay this fruit research station which is started under expert control will open out avenues for further expansion. As in all cases of special preparations a market for such products is really created, and not necessarily existing. In the expanding use of such products as fruito, vimto and the ice frute, and in our many classes of aerated drinks, we see conditions for development which will be fruitful of results for the future of the fruit industry.

I have in this short discourse given you some broad lines of improvement in the marketing of fruits, necessary for future expansion.

I have given you indications of our supply, the nature of imports and the movements of home produce. I have also indicated to you the lines on which future research work on varieties, cultural methods, storage and the transforming and preserving of fruit, will help us. I have stressed the need for standardisation in our marketing methods and the growth of healthy organisation towards such ends. I am sure that the fruit research station on which devolves some of the technical problems of our future will give ample scope for the expansion of the activities which the marketing staff are now engaged in.

AGRICULTURE IN BURMA

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[Under the auspices of the Madras Agricultural Students' Union, a meeting was held on Monday the 16th December, when Mr. K. Ramiah, who had recently been on a tour to Burma, spoke on 'Agriculture in Burma'. Mr. R. C. Broadfoot, President of the Union, who presided on the occasion, referred in the course of his introductory remarks, to the impending separation of Burma from India and observed that apart from its importance as a producer of rice, timber, oils and minerals, this separation would result in Burma having a commendable say in the future trade of the East.

Below is an abstract of Mr. K. Ramiah's speech. —Ed. M. A. J.]

Rice and Agriculture. The title I have chosen, sounds ambitious, but, actually a talk on Burman agriculture will essentially be a talk on rice cultivation in Burma; because, rice is the most important and wealth-producing crop of the province. This can be gauged from the fact that the total value of rice and rice products exported annually from Burma, is to the tune of 30 to 40 crores of rupees, while the total value of exports of other products in which Burma is rich, namely, minerals, timber and oil, all put together amount to only 20 crores. In fact, the whole population in Burma is directly or indirectly dependent on rice.

The Agricultural Zones. Agriculturally Burma can be divided into three zones:—a wet zone on the north, a dry tract in the middle, and another wet zone in the south. The northern zone is a hilly tract most of the areas being unfit and still unexplored for cultivation. A number of mountain ranges start from this part of the country, the most important being the Arakham, the Shan and the Pegu ranges. The total rainfall in this zone amounts to about 80 inches annually. The middle zone is dry and crops are raised here only with artificial irrigation. Most crops including rice, are grown only in this area, which receives only about 20 to 30 inches of rainfall. Lower Burma, the third and the most important zone receives the full benefit of the south west monsoon with about 100 inches of rain while a narrow strip of country between the coast and the mountain ranges both on the west and eastern ends of this zone receives even as much as 200 inches. In

addition to these three there is the Shan States, a big plateau of 3 to 5 thousand feet above sea level, practically undeveloped. It is stated that it may prove a valuable tract for sheep farming.

The importance of rice. As mentioned already, rice is the most important crop, occupying 75 % of the cultivated area or about 13 million acres, of which nearly 11½ million acres are in Lower Burma, about a million being in the middle zone. The only difference between these two zones is that in Lower Burma, rice is cultivated entirely as a rainfed crop, while in the dry middle zone it is grown with artificial irrigation as in Madras. The immensity of rice cultivation in Lower Burma is prominently brought to one's notice, as one travels through this tract. One sees on all sides vast sketches of paddy fields, with green and luxuriant crop and with trees almost absent in the landscape except on the borders of creeks. The only relieving feature is the short palm, *Nipa fruitescens*, which looks like a big fern, with leaves like those of the coconut. These leaves are used for roofing houses and occasionally toddy also is tapped from this palm.

The History of Rice Cultivation. Until the middle of the 19th century, Burma rice was not known outside that country the production being just sufficient to meet the internal consumption. The lower Burma was all a swamp and undeveloped. There were no settlers and no roads, and rice cultivation was only done in patches here and there, like the hill cultivation in Malabar and Agency tracts. After the British occupation however, (about the years 1870—1880), development took rapid strides. Government opened up roads, put up embankments and bunds to prevent flood water getting in, and dug channels to drain off water, and serve as water ways. Thus land which was previously subject to floods and was precarious for rice cultivation, now became eminently suitable for the rice crop. Settlers from North Burma moved over, as also emigrants from Madras, to occupy the reclaimed swamps on which lands were given on favourable leases.

The Madras emmigrants were chiefly *Nattukotai Chetties*, who financed the cultivators and it is the enterprise of these Chettiars, that has been responsible, in no small measure, for the development of the Burma rice industry. The venture of these people was something like a speculation in financing a new and promising business, and although it has been alleged that in their financial dealings they have not been overscrupulous in their methods, it must be remembered that these people far away from their homes were taking a great risk. It is now estimated that the total amount invested by these *Chetties* in lower Burma amount to nearly 60 crores of rupees.

The Cultivation. The cultivation of the crop starts with the south west monsoon. The soils of lower Burma are like those of our deltas, only they contain more silt than clay, as different from

Madras soils which contain a bigger fraction of clay than silt. The cultivation details are not very different from those obtaining here, but one interesting thing is that the lands are ploughed only once, after which two implements unknown to us, one the Burmese Harrow, and the other the Burmese settoon—which has a number of rotating blades which cut weeds and curdle the soil—are passed a number of times. Considering that with a single pair, a tenant is able to finish 2 acres a day with these implements, they are worthy of trial in our country, as their adoption would result in considerable saving of expenses towards preliminary cultivation; and there is room to think, that these implements may be effective on our soils also to provide the required tilth, because, the soils of the dry middle zone, unlike those of lower Burma, are clayey like those of our deltas, and even in this zone, these implements are in vogue.

There is practically no manuring given to the crop, although recently the Agricultural Department have been experimenting with fertilisers and have found Ammonium Phosphate 20 : 20 to give increased yields; this however has not been found to be paying enough in the present depressed state of the rice market.

The harvest is peculiar in that the whole plant is not cut, but only the earhead with about a foot of the straw. Actually the plants grow very tall, 5½ to 6 feet, and some times even 7 feet, and the straw is stiff and coarse; after harvest, the straw is either left in the field and grazed by cattle, or some times burnt away; some times it is also cut off and used for roofing houses in towns and villages.

Holdings. The main difference between Madras and Burma in the size of the holdings; in our deltas it is probably less than 4 to 5 acres, but in lower Burma it is somewhere between 22 to 25 acres and in upper Burma 10 to 15 acres. A tenant usually manages 25 acres, with a single pair, hiring out an extra pair for the season only and the animals are after all small sized, just like our small *Kangayams*. This of course is due to the thinner population with less pressure on the land unlike our deltas, and thus the bigger size of the holding is a definite factor that goes towards decreasing the cost of production of rice in Burma.

Land tenure etc. More than 50% of the holdings are managed by tenant cultivators. In recent times, a new phase has come over the old state of things. The old Burmese settlers, have gradually become more and more indebted to the *chettiars* who have been financing them and with no prospect of the loans being returned, the land has gradually passed over into the hands of absentee landlords. This can be seen from the fact that while in the earlier years only 6% of the holdings was owned by chettiars, in 1935 it is estimated that nearly 22% of the area in lower Burma is owned by them. This state of affairs has been mainly brought about by the Burmese trait, which is a national characteristic almost, namely a pleasure-loving disposition with never a

tendency to save or to repay loans. In spite of his big holdings, the Burmese ryot is always involved in debt.

Rice varieties. There are three classes of varieties agriculturally, the early, the medium and the late; the last two of 5½ to 7 months' duration are the most important and comprise about 70% of the total. There is no variety less than 4½ months in duration.

Out of a total production of 7 million tons nearly 3½ million tons are exported as milled rice, and thus, trade requisites have resulted in a number of classifications amongst the rice exported from the country.

There is an impression here that Burma rice is not good; this is hardly the case. What actually happens is, that Burma rice is sent to two markets, the eastern and the western. In the former in which is included South India, the chief consideration is cheapness and in the latter, those of European countries, the criterion is quality, Thus price outside decides quality, and therefore, South India which imports only the cheap rices gets the poorer quality. There are several fine varieties of rice and it will not pay to import them into Madras.

The Agricultural Department and Rice. In Madras our chief aim is the increase of yield; in Burma, however, while reasonable yield is desired, the attention of the department is directed more towards the evolution of strains with better milling qualities. The milling industry has thus a large voice in directing the policy of the Agricultural Department. There is always a close co-operation between the department and the millers and no variety or strain is passed out by the department which has not been approved by millers.

Seed farms run by the Department are more highly developed than in India. A large amount of *poromboke* unassessed lands classed as grazing areas which are leased out to tenants on definite conditions, have been handed over to the Agricultural Department for use as seed farms, and agricultural officers corresponding to our Demonstrators, are put in charge of these areas. Each demonstrator has about 10 or 12 seed farms under him. There are two kinds of seed farms; the major seed farms are those at the headquarters of the demonstrator, and provided with threshing floor and storing fecilities. The minor seed farms are with the tenants themselves with a supervision by the demonstrator. In 1935, there were 23 major farms with a total area of 2800 acres and 153 minor farms with an area of 9000 acres, the total produce distributed as seed being nearly 8 thousand tons of paddy. The Agricultural Department works in close co-operation with the millers and often act as the buying agents of the mills.

Milling and Trade. Milling in Burma is different from our conception of what it is in our country, their mills being very much bigger, some with a turn-over of even 200 tons of rice per day.

The trade is mostly in the hands of Europeans, and is a highly organised industry with headquarters in England and with a large amount of English capital. These English companies are mostly in charge of the big mills and, creating a demand in the United Kingdom carry on a flourishing trade. The trade with India and Ceylon is not done by these companies but by Gujeratis from Bombay; there are neither cultivators nor millers, but only brokers; they get telegraphic communications of market fluctuation and buy and sell rice. Moghul street, Rangoon, where the rice brokers all reside, strongly remind one of the Wall street of New York or the Stock Exchange of London in a smaller degree.

The trade is keenly alive to tastes and demands. Twenty years ago, only white rice was being exported; now, since there is a demand for parboiled rice in South India, it is being prepared and exported. The millers who are doing business on a large scale are out to improve the processes of preparing parboiled rice and are keenly alive to the problems arising in it. Whenever necessary, they engage chemists specially to attack special problems. In the preparation of whole rice for the western markets some of the finer kinds give only about 25 to 30 % head grain the rest being classed into different grades of broken rice. This broken rice, a by product, is usully sent to south India where there is a ready sale. There is a complaint that they have lost some of this trade since the coming in of Siam in the picture.

Other Crops. The other crops grown, besides rice, in order of area and importance are beans, gingelly, groundnut, sorghum, maize, chillies, rubber and sugarcane. Most of these are grown in the dry middle zone, and also on a narrow strip of tract on either side of the Iravady, the latter known as the riverine corresponding to our *Padugai*, cultivation on river banks.

Conclusion. The rice cultivator in Burma has a number of advantages; he spends comparatively less on preliminary cultivation, his implements are more efficient than the plough; he uses no manure, the Iravady brings him plenty of silt, his yields compare well with ours about 1700—2000 lb; his assessment is low, only about 3 to 5 rupees; his holdings are large; and his mode of transport is cheap and efficient.

[In his concluding remarks, the Chairman congratulated Mr. K. Ramiah on his extremely practical and interesting paper and observed that Burma's example, in a number of instances, was worth being followed. There was no reason, why with a number of Irrigation Projects launched in our Presidency, Madras should not be self-sufficient in the very near future, as regards her rice production.

At the instance of the Chairman, a number of questions were put to the lecturer who in the course of his replies, gave the following further information about Burma.

1. The grazing problem is not serious; the villages scattered, the cattle are few and there is enough straw left on the fields after the harvest.

2. Green manuring is not done and in fact, when tried, was a failure; this is because, no rains are received at all during summer, when cracks develop in the soil, making it unfit for crop growth; the soil again gets soaked only with the receipt of rains in May.

3. He was inclined to think that if not the *settoon*, at least the Burmese harrow could be used with advantage on our soils.

4. The size of fields varied from 20 cents to 5 acres depending on distance from channels.

5. The labour population, not only for agricultural but for other purposes, is mostly supplied by emmigrants from Vizagapatam, who regularly sail over to Burma in batches, during the season; this is because Burmese labour is poor.

6. The cost of production of rice per acre, which 3 years ago was about Rs. 15 now ranges from Rs. 20 to 22]

POPULATION AND PRODUCTION IN INDIA, 1920-32.[1]

By P. J. THOMAS, *Professor, Madras University.*

The increase of 10·5 per cent. in the population of India between 1920 and 1930 has created considerable uneasiness in many quarters. The author of the Census Report, 1931, views it with alarm and this is shared by a large number of publicists. Mr. R. W. Brock, formerly the Editor of *Capital*, made the following statement at a meeting of the East India Association in 1932:—'So far as the official figures indicate there has certainly not been any increase in India's agricultural and industrial production, in any way proportionate to the increase of her population, and the only possible inference appears to be that there has been a fall in the average income and therefore the average standard of living.'[2] This startling statement challenges a statistical examination of the problem.

There is one serious difficulty in accurately estimating production in India. Not less than 70 per cent. of the people are dependent on agriculture, but the available statistics of agricultural production are hardly reliable, as they are based on a very imperfect system of crop forecasts. The forecasts of crop outturn in India are based on (1) area under cultivation; (2) the standard of normal outturn per acre; and (3) the condition factor or the annavari estimate. The figures of area are supplied by the Revenue Department, and are fairly reliable except in the permanently settled tracts of Bengal. Bihar and Orissa, and parts of the United Provinces. The standard outturn is 'the average yield on average soil in a year of average character'. The outturn figures are deduced from crop-cutting experiments, but in most provinces such experiments have not been systematically carried out, and in some they have not been undertaken since 1919; and although in the meantime considerable increase in the area under improved varieties of crops has taken place, the figures adopted in 1919 are still used for estimating crop yields. The worst link in the chain is the annavari estimate which is submitted by the village patwari. The annavari represents the relation of the crop reported on to the normal crop per acre, but it is based on guess-work.

The result is that year after year, the crop forecasts made have proved either an under-estimate or an over-estimate, generally the former. In the case of two crops—cotton and jute—it is possible to test the forecasts by a post-mortem examination. Such a test showed that in both cases the forecasts had been under-estimated. In the case of cotton, the difference is 17 per cent. and in the

1. I am grateful to Dr. A. L. Bowley and Mr. Sundararama Sastri for help in regard to the method and the tables.

2. *Asiatic Quarterly*, 1932, p. 440.

case of jute, 18·6 per cent. The annual average production of cotton for ten years, was 5,380,000 bales, but the post-mortem examination showed that it was 838,000 bales less than the actual crop of those years. In the case of jute, the divergence has been even wider. In a single year (1922) the difference came to 52 per cent. (The forecast was 47·37 million bales; but the actuals came to 64·36 million bales). The area under improved crops has been increasing at a rapid pace during the decade 1920–30; from 2,507 acres in 1920–21, it rose to 12,016 acres in 1930–31. It is true that such under-estimation has made the statistics rather defective as commercial information, but the error is 'systematic', and as we are here dealing with only 'relatives', it does not affect the result tangibly.

The position in respect of industrial production is slightly better, because although there are no recorded statistics of production in unorganized industries, the statistics of production in the organized industries are fairly accurate, within certain limits. In the case of textiles (cotton and jute), we have statistics for a fairly long period, and for iron and steel, sugar, coal, paper, etc., we have complete statistics for the last decade. The publication, from September 1933, of the *Monthly Survey of Business Conditions* has greatly improved our knowledge of production in the chief organized industries, but we have still only a hazy knowledge of unorganized industries, which employ the great majority of our industrial population. Hence the need for a comprehensive economic survey, as recommended by Dr. Bowley and Mr. Robertson.

The progress of industrial production has been rapid since the War. The advance has been phenomenal in sugar and large in cement and in iron and steel. The value of organized industrial production today may be between one-third and one-half of that of primary products. The progress has been even more rapid since 1929.

Four statements are given below to illustrate them. The first two deal with agricultural production (chief crops) and the next two deal with industrial production (chief industries). The period taken for the analysis is the 12 years from 1920–21 to 1931–32. The average of the estimated production (both agricultural and industrial) during the years 1920–21 and 1921–22 is taken as the base. On this basis the relatives of the several commodities for the successive biennial periods are calculated. The general or composite index number of production for each biennial period is a weighted average of the relatives, the weights being proportional to the values of the several commodities. Throughout, the price per unit of the commodity is taken as constant. For all agricultural commodities the average wholesale prices in the years 1920–21 and 1921–22 (base period) are taken as the prices per unit. As prices for all the industrial products for the base period are not available, those of the prices which are given in the *Indian Trade Journal* (cotton yarn, piecegoods, jute bags and gunny cloth, and sugar) are taken for that period, and the rest are standard prices recommended by the Tariff Board. These prices are only a means to get the weights, and slight variations in weights do not alter the composite index number to any material extent.

In Tables I and III average estimated production and value of each commodity are given; and in Tables II and IV, the relatives with the respective weights assigned to each commodity are given. The formulae used in calculating the composite index number are:—

1. Weighted arithmetic mean.

$$100 \times \frac{\Sigma p_0 q_1 \times \frac{q_1}{q_0}}{\Sigma p_0 q_1}$$

p_0 price per unit of the commodity in the base year.
q_0 production of the commodity in the base year.
q_1 production of the commodity in the given year.

TABLE I

Agricultural Production (Quantity and Values)

(*Average of two years*).

Commodity.	Average Price per Unit in 1920–21 and 1921–22 (base period).	1922–23 and 1923–24		1924–25 and 1925–26		1926 27 and 1927–28		1928–29 and 1929–30		1930–31 and 1931–32	
		Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)
Rice (millions of tons) ...	Rs. 9 per cwt.	31	558	30·9	556	29	504	31·5	567	32 6	587
Wheat (millions of tons) ...	Rs. 9—1—0 per cwt.	9·9	179	8·8	159	8·4	152	9·5	172	9·2	167
Sugar cane (millions of tons)	Rs. 55 per 500 lbs.	3·2	79	2 8	69	3·3	81	2·7	67	3·6	89
Tea (million lbs.)	Rs. 0—9—3 per lb.	343	20	369	21	392	23	418	25	392·6	23
Cotton (million bales) ...	Rs. 50—9—0 per cwt.	5·2	94	6·2	112	5·5	100	5·5	100	4 6	83
Jute (million bales)	Rs. 300—6—0 per ton	8·3	45	10·5	57	10·1	55	10·7	58	5·7	31
Linseed (thousand tons) ...	Rs. 12—6—0 per cwt.	568	14	551	14	377	9	351	8	394	10
Rapeseed (thousand tons) ...	Rs. 11—6—0 per cwt.	1179	28	1065	26	922	22	1002	23	1014	24
Sesam (thousand tons) ...	Rs. 15—4—0 per cwt.	463	14	467	11	479	14	430	13	495	15
Groundnuts: nuts in shell (millions of tons)	Rs. 13—4—0 per cwt.	1·2	24	1·8	36	2·4	48	2·9	58	2·9	58
Indigo (thousand cwt.) ...	Rs. 41—9—0 per cwt.	·44	2	25	1	15	1	14 5	1	12	1
Coffee (million lbs.)	Rs. 59—3—0 per cwt.	·22	2	26	3	35	4	33·5	4	33	4
Rubber (million lbs.)	Rs. 78—0—0 per cwt.	13	1	18	2	25	3	27·5	3	22	2
Jowar (millions of tons) ...	Rs. 6 per md.	5·8	95	5·6	91	5·9	96	6·3	103	6·6	108
Bajra (millions of tons) ...	Rs 6—5—0 per md.	2·3	41	2·1	37	2·5	44	2 0	36	2·7	48
Maize (millions of tons) ...	Rs. 5 per md.	2·1	29	1·8	25	2 1	29	2 2	30	2·35	33
Gram (millions of tons) ...	Rs. 7 per md.	4 9	94	4·1	78	3·6	69	2 9	58	3·6	69
Barley (millions of tons) ...	Rs. 10—4—0 per cwt.	3·0	62	2·6	54	2·4	50	2·4	48	2·4	48

TABLE II

Agricultural Production—(Index Numbers)

Base: Average of 1920–21 and 1921–22 = 100.

Commodity.	Average of 1922-23 and 1923-24		Average of 1924-25 and 1925-26		Average of 1926-27 and 1927-28		Average of 1928-29 and 1929-30		Average of 1930-31 and 1931-32	
	Index.	Weight.	Index.	Weight.	Index.	Weight.	Index.	Weight.	Index.	Weight.
Rice	102	40	101	41	95	37	103	42	107	42
Wheat	121	13	107	12	102	12	116	13	112	12
Sugar-cane	128	6	112	5	132	6	108	5	142	6
Tea	111	1	119	1	127	2	135	2	127	2
Cotton	130	7	155	8	138	8	137	7	115	6
Jute	177	3	223	4	215	4	228	4	121	2
Linseed	161	1	153	1	107	1	99	1	115	1
Rapeseed	117	2	105	2	91	2	99	2	100	2
Sesam	103	1	104	1	106	1	96	1	110	1
Groundnuts	120	2	180	3	240	4	290	4	290	4
Indigo	80	...	45	...	28	...	26	...	22	...
Coffee	105	...	124	...	167	...	160	...	157	...
Rubber	118	...	164	...	228	...	250	...	200	...
Jowar	89	7	86	7	91	7	97	8	102	8
Bajra	100	3	91	3	109	3	87	3	117	3·5
Maize	91	2	78	2	91	2	96	2	102	2·5
Gram	111	7	93	6	82	5	66	3	82	5
Barley	107	5	92	4	86	4	86	3	86	3

Composite Index Numbers

	1922-23 and 1923-24	1924-25 and 1925-26	1926-27 and 1927-28	1928-29 and 1929-30	1930-31 and 1931-32
Weighted Arithmetic Mean ...	111	112	113	111	116
Aggregative type	109	107·4	106	102	112
Median	100	106	108	101	115

TABLE III

Industrial Production (*Average of two years*).

Commodity.	Average price in base period.	1920–21 and 1921–22	1922–23 and 1923–24		1924–25 and 1925–26		1926–27 and 1927–28		1928–29 and 1929–30		1930–31 and 1931–32	
		Quantity.	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)	Quantity.	Value (Crores of Rs.)
*Cotton yarn (millions of lbs.)	Re. 1—8—0 per lb.	677	661·5	74·55	790·3	88·91	808	90·9	741	83·36	916·5	103·11
Cotton cloth (millions of yds.)	Rs. 0·4 per yard	165·6	1713·5	68·54	1962·0	78·48	2324	92·96	2116·5	84·66	2651·5	106·06
Jute bags (millions)	Rs. 0·46 per bag	438·3	365·5	16·81	419·4	19·29	437	20·06	480·4	22·10	478·2	22·00
Jute cloth (millions of yds)...	Rs. 0·2 per yard	1314	1187·5	23·75	1402·5	28·05	1482	29·64	1560·5	31·21	1461	29·22
Sugar (thousands of tons) ...	Rs. 470 per ton	74·3	84·4	3·97	79·4	3·74	120·4	5·62	105·0	4·94	189·9	8·93
Coal (millions of tons) ...	Rs. 9 per ton	186·5	19·4	17·46	21·1	18·99	21·7	19·53	23·0	20·70	22·8	20·52
Cement (thousands of tons).	Rs. 53 per ton	112	193·0	1·03	321·0	1·71	512	2·71	555	2·95	555	2·95
Paper (Do.).	Rs. 464 per ton	29	25·0	1·16	27·1	1·26	33·0	1·53	39·1	1·82	39·1	1·82
Pig Iron (Do.).	Rs. 34·5 per ton	339·6	454·0	1·57	876·3	3·02	1021·3	3·52	1116·5	3·85	1085·5	3·75
Steel (Do.).	Rs. 180 per ton	119·2	131·3	2·36	284·0	5·11	394·5	7·11	344·0	6·19	442·0	7·96

* As we are here comparing the growth of industrial activity at different periods, the question of double counting does not arise.

TABLE IV

Industrial Production: Index Numbers

Base: Average of 1920-21 and 1921-22 = 100.

Commodity.	1922-23 and 1923-24		1924-25 and 1925-26		1926-27 and 1927-28		1928-29 and 1929-30		1930-31 and 1931-32	
	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.	Index. No.	Weight.
Cotton yarn	97·5	35	103·5	36	119·5	33	109·5	32	136	34
" cloth	103·5	32	118·5	31	140·5	34	128·0	32·5	161	35
Jute bags	83	8	96	8	100	7	110·0	8	109	7
" cloth	89	11	107	11	112·5	11	118·5	12	112	9
Coal	104	8	113	8	116	7	126	8	122	7
Sugar	114	2	107	1·5	162	2	141	2	256	3
Steel	110·5	1	238	2·0	331·5	3	289	2	320	1
Pig Iron	129·5	1	258	1·0	301	1	329	1·5	371	2·5
Cement	172·5	1	286·5	1·0	457·5	1	495·5	1	504	1
Paper	86	1	93·5	0·5	114·0	1	134·5	1	138	0·5
Composite Index Numbers										
Weighted Arithmetic Mean ...	**99**		**115**		**137**		**130**		**151**	
Aggregative type	**98**		**111**		**128**		**122**		**144**	
Median	**104**		**110**		**130**		**131**		**149**	

2. Aggregative type.

$$100 \times \frac{\Sigma p_0 q_1}{\Sigma p_0 q_1 \times \frac{q_0}{q_1}}$$

3. *The Median.*

The weighted arithmetic mean is the biased II type of Fisher (refer Fisher's *Making of Index Numbers*). In Appendix II, Art. 8 of the same book it is pointed out that for the arithmetic mean this is the best system of weighting, because the upward bias possessed by the average has to be counteracted by a downward bias in weighting. As for the aggregative type, it is pointed out by Fisher that the two types differ very little and hence, for the sake of convenience in calculations the given formula is chosen.

In result, we obtain the following indices of population and production during the period :—

	1920–21 to 1921–22	1922–23 to 1923–24	1924–25 to 1925–26	1926 27 to 1927–28	1928–29 to 1929–30	1939–31 to 1931–32
Population[1]	100	102	104	106	108	110·4
Production[2]						
(1) Agricultural	100	111	112	113	111	116
(2) Industrial	100	99	115	137	130	151

It may be clear from the above that agricultural production has kept pace with population, and that industrial production has increased much faster than population. In the decade 1920–30, population increased by 10·5 per cent., but this is abnormal for India, seeing that in the three previous decades, population increased only by 2·5, 7·1 and 1·2 per cent., respectively. The increase of population between the biennial periods 1920–21 to 1921–22 and 1930–31 to 1931–32 had been 10·4 per cent. but agricultural production increased by about 16 per cent. and industrial production by 51 per cent. during the same period. The slow growth of agricultural production is due largely to the declining demand for cereals, especially dry grains, which are being supplanted by rice and wheat. India formerly exported large quantities of wheat, but today most of it is consumed at home. Thus some classes at any rate have raised their standard of living. Considering the limited scope for the expansion of rice cultivation, it is likely that India will have to depend increasingly on imported rice in future.[3] However, there is a large compensating factor in the steady growth of industrial production.

A decade, even twelve years, is far too short a period for correlating population and production. The thirty years between 1900 and 1930 may provide better scope for such a correlation. Full statistics of industrial production for the period are not available, and therefore only cotton yarn, piecegoods, jute cloth and gunny bags, and coal are taken, but the figures for agricultural production are fairly complete. The following table gives quinquennial indices of population and agricultural production, worked out by Fisher's weighted aggregate index method.

Period.	Population	Agricultural production.	Industrial production.
1900–01—1904–05	100	100·0	100
1905-06—1909–10	104	103·0	142
1910–11—1914–15	107	123·5	187
1915-16—1919–20	103	124·5	255
1920–21—1924–25	109	120·0	251
1925–26—1929-30	113·5	129·0	289

1. It is assumed that population increased uniformly from year to year.
2. Indices worked on the Weighted Arithmetical Mean.
3. See *Madras Census Report* (1931) I, p. 47.

Population increased by 19 per cent. between the two censal years 1901 and 1931, but if we compare the first and last quinquennia, as in the case of production, the increase is only 13 5 per cent. Thus, when population increased by 13·5 per cent. production increased by 29 per cent. The index would be much higher if we take the arithmetic mean; for the production of several commodities increased enormously during the period. Groundnuts, for example, increased from 93,000 tons to 2,466,000 tons, i. e. 2,500 per cent. Industrial production has also increased rapidly; the annual production of cotton textiles increased from 500 million yards in 1900 to 2,654 million yards in 1931-32. Hardly any pig iron was made in 1900; but 1,085,000 tons of it was made in 1931-32.

Thus, whatever period we may take, there is no indication that population has outstripped production. It does not mean that India is not overpopulated. It may, or may not be; that is a different question, and I do not propose to deal with it here. All I can see from the statistical study carried out is that if India was not overpopulated in 1900—and that is the view of some—it is not overpopulated now. Production has been keeping pace with population; and in some lines—e.g., industry, commercial crops—it has increased at a much more rapid pace than population. And this progress has been kept up during the world depression—and that is a significant fact. [From the *Madras Univ. Journal* Vol. VII, No. 2, pp. 93—102 by courtesy of the Author].

ABSTRACTS

A simple apparatus for measuring the compactness of soil in the field, and some results obtained in a cultivation experiment. By O. V. S. Heath (*The Empire Jour. of Experi. Agri.* vol. ii. No. 7 pp. 205—212). The article describes a simple and easily-made apparatus, for measuring compactness in a soil, the method of working it, and the results obtained with it. Based on the principle of the stratometer, the apparatus consists of a tripod, supporting an iron rod which bears at its lower end a steel cone. A length of steel pipe surrounding the rod, serves to carry the force of impact direct to the cone, the rod only serving as a guide. The weight is lifted to a mark on a graduated scale behind and allowed to fall freely, thus driving the point into the soil. A "soil plate" placed flush with the soil, and provided with a projecting tube which prevents loose soil falling into the hole made by the steel cone, completes the apparatus.

The apparatus was used on a cultivation experiment with three treatments, which were designed to give different degrees of soil compactness, namely:—normal, grubbed and compressed soil,—and results obtained by the apparatus are very comparable and satisfactory. More than any thing else, cheapness of its construction, should appeal, to all who desire a fairly satisfactory method of comparing soil compactness in different treatments. M. R. B.

Activation of cambial growth by pure Hormones. By R. Snow (*The New Phytologist*, Vol. 34, No. 5, p. 23). An extremely interesting paper which throws light on the possible nature of the hormone present in leaves, which is responsible for cambial growth. Urine being a good and abundant source of auxin and other hormones, the ether-soluble extract of urine was tried on young sunflower seedlings, which were decapitated before applying the solution to the cut surface. The experiment was also done in the hypocotyl-region and the results show that cambial growth is activated by solutions in gelatine of synthetically prepared hetro-auxin and auxin-£—in minute concentrations. From the results, it is concluded that the normal cambial growth is promoted in plants by the same growth—hormone (perhaps auxin-£) in young leaves. M. R. B.

The non-protein nature of a fraction of soil organic Nitrogen. By A. W. J. Dyek and R. R. Mckibbin (*Can. Jour. of Res.* Vol. 13, No. 5, pp. 264—269). In the case a number of samples of organic soils, drawn from widely different locations in the

province of Quebec, the authors found that there were considerable differences in the percentages of nitrogen, as determined by the Kjeldahl and the Dumas methods. The latter always gave a higher figure, the difference between the two methods varying from 6·4 to 29·6% of the total nitrogen. The results therefore lend support to the belief, that not all the nitrogen in the soil is of a protein nature and that the non-protein nitrogen which may be an appreciable fraction, is not estimated by the Kjeldahl method. M. R. B.

Some factors affecting the influence of soy beans, oats, and other crops on the succeeding crop. By D. R. Dodd and G. G. Pohlman. (*Bull. 265 Agri. Expt. Stn. West Virginia Univ.*) Different investigators having reported different results as regards the effect of soy beans (grown for hay and for seed) on the succeeding crops, the authors attempted to study this effect in a three fold direction.

1. to determine the effect of a crop of soybean hay as compared with oats on the yield of corn, wheat, buckwheat, potatoes and oats, following. 2. to determine the effect of respective crops of oats, buck wheat, potatoes, wheat and corn or the yield of following crops of soy beans and oats, and 3. to determine the effect of these various crops and cultural treatments on the nitrate and moisture content of the soil, and the relationships of these contents to the yields of crops.

Results obtained showed that as regards (1), the yields of oats (both grain and straw), wheat *grain* and corn grain were significantly higher when following soybeans than when following oats, but as regards potatoes, clover and wheat straw, the difference was not significant. As regards the 2nd point, wheat was found to be the best crop, to precede oats or soy beans. During the growth of soy beans, the nitrate content of the soil diminishes reaching a minimum at the time of removal of the crop; the soil recoups gradually after the removal of the crop and therefore sufficient time (about 3 weeks) should be allowed after the removal of the soy beans, for the store of available Nitrogen to be replenished, before the next crop is planted; as an alternative an addition of 50 pounds of Sodium Nitrate per acre, may be applied. M R. B.

Gleanings.

Bees in Court. Near Amity, N. Y. lived two brothers, surnamed Utter. One was a peach grower by general occupation while the other added beekeeping to his various other rural pursuits. For some time a bad feeling existed between the two, and then Peach Utter conceived the idea that the bees of his brother, the beekeeper, were injuring his peaches and even killing the trees. Upon these allegations he based a complaint and brought a suit for damages against Beekeeper Utter. The judge gave a judgment of 25 dollars and costs against Beekeeper Utter. On this, the National Beekeeper's Association, America whose attention was called to the matter, employed competent counsel and took the matter up to the country court. The final trial which came off on 17th, 18th and 19th December 1901, before the country court was stubbornly contested by both sides, about 30 witnesses were examined and the jury after 10 minutes' deliberation brought in verdict for the defendent, Beekeeper Utter.

There were in attendance, witnesses ready to render expert testimony to the fact that, bees do not and cannot puncture sound fruit; some laughable testimony was given by the witnesses for the prosecution, like the statements ' that the bees used their horns (antennae) to make holes in the fruit,"—which only illustrated the prevailing ignorance in regard to bees. Professor Benton one of the defence witnesses showed by live and dead specimens of bees, and also by charts

which he brought for the occasion, that in his opinion it was a physical impossibility for the bees to puncture fruits with their jaws or mandibles; that the jaws of bees were very different from those of wasps and other insects having cutting edges or teeth × × × × (*American Bee Journal*—Dec. 1935. P. 571.)

Where Spores score over Human Beings. Surviving conditions under which man would die, tiny spores of important plant diseases are growing in a laboratory of the 'Department of Agriculture, Washington, after journeying nearly 13¾ miles into the stratosphere, with the balloon *Explorer II*. Discovery that spores can live after being sent to an altitude of 72, 395 feet, is the first scientific conclusion from the recent ascension. × × × × The spores carried aloft had to withstand (1) temperatures lower than 65 degrees below Zero Fahrenheit (2) such a low atmospheric pressure that man could not live in it (3) ultra-violet rays from the sun which never reach the earth and which are capable of killing some forms of life (4) ozone & (5) extreme dryness. (*Science-Suppt.* vol. 82, No. 2136, p. 12).

Sugar Windows! Slapstick comedies are now few and far between these days but even then a movie villain is now and then tossed through a window. When you see this, don't cringe for fear that the glass will cut the actor, for, this glass-like pane has been prepared from sugar. (*Sc. Amer.* Jan. 1936, p. 50).

Improvement of memory by sleep. If a person memorises certain kinds of material perfectly and goes to sleep immediately afterwards, he will recall most of it, and also relearn the whole thing more economically after a lapse of 24 hours, than if he waits even a few hours before going to sleep, according to Dr. H. M. Johnson, Professor of Psychology, Washington. Experiments based on different methods, made by Dr. Rosa Heine Katy and Joseph O' Brien at the University of Gettingen, showed that all the subjects who were studied, were better able to recall and also relearn material that they had learned by rote and partially forgotten, if they slept for 8 hours and then worked for 16 hours, than if they distributed their rest and activity in any other way during the 24 hour period. × × × × (*Sc. Suppt.* vol. 82 No. 2137, p. 15.)

The Composition of some Common Foods :—

Food.	Percentage of				Calorie (energy value) per lb.
	Protein.	Fat.	Carbo-hydrates.	Salts.	
Wheat.	12·0	1·7	73·7	1·5	1750
Cambu.	10·0	5·0	74·2	2·0	1750
Cholam.	8·9	3·1	71·0	2·5	1750
Rice.	7 5	1·8	82 0	0 8	1584
Grams.	19 0	4·3	54·0	2·8	1530
Lentils.	25·0	1·5	60·0	6·0	1600
Peas & Beans.	24·0	1·5	60 0	3 0	488
Soya Beans.	40·0	20·3	24 6	4·8	2100
Linseed.	24·0	40·0	26 0	2·0	2270
Groundnut.	24·0	45·0	22 0	2·0	2450
Meat.	24·0	2·5	...	1 5	576
Eggs.	14·8	10·5	...	1 0	720
Milk (Buffalo's)	4·0	7 to 9	4·0	0·8	480
Potatoes.	3·0	0·12	14·2	1·0	556

(From Pamphlet No. 7—Bombay Presy. Baby and Health Week Association).

Correspondence.

Growing Sugarcane in the Tanjore Delta.

Rao Bahadur C. S. Subramanyam writes from Mayavaram :— Some years ago it was the common opinion among farmers and agricultural officers that sugarcane cannot be grown in the wet lands of this delta. The imposition of the protective duties against the import of sugar was not taken advantage of by the Tanjore farmer, though it has been utilised very profitably by the farmers and industrialists in Northern India. About three years ago different varieties of cane were planted in the wet fields of the Government Aduthurai Farm, where the land is a flat level block that does not drain quickly after a heavy rain. As the results were encouraging, here and there some farmers grew sugarcane with varying success. The failures were due, as I have since ascertained, to their not adopting the correct method of cultivation as also to the unsuitable choice of land.

Early last year, I tried growing sugarcane on my farm and chose a wetland field somewhat higher in level which would drain off quickly after a heavy rain. The local method of raising the crop is to plough the land 3 or 4 times and plant the setts in dry land beds of 4 or 5 feet square. Irrigation water is obtained either by diverting the adjoining channels or raising it from a well by means of a *picotah*. The local Agricultural Demonstrator advised me to dig trenches one yard apart, put in farmyard manure and channel silt and plant the setts a foot apart, after a preliminary watering. 1500 setts of Fiji. B. and about 800 setts of Co. 281 and Co 285 were thus planted in about 12 cents of land between the 10th and 15th of May. The Fiji B. seed was obtained from a friend, and the other varieties from the Aduthurai Farm. For the first two months, the crop was watered once a week by raising water *(picotah)* from a well previously sunk for the purpose. After the freshes arrived in the river, the channel water supply was utilised, and irrigation became easy. About two months after planting, I applied about 5 maunds of groundnut cake and earthed up the ridges. A second earthing up was done in August, and thereafter, not much attention was required until the cane came to harvest in March. The cane was exhibited at the Srirangam Exhibition early this year and also at Aduthurai at which places it earned a silver medal and an iron plough respectively.

The reported failures are due to choosing a plot which would not drain off, planting a large area without trying the suitability of the land in the first instance, and not seeking the advice and guidance of the Demonstrator—in brief, attempting to do the job without knowing the ropes. I do not think that all the villages in this delta are suitable for sugarcane cultivation, because, the fields therein get water-logged after some continuous or considerable rain. But a very large number—nearly half—of the villages have some higher-level lands in them, and on these, cane could be grown successfully. Wetlands of this type score over dry lands as the cost of lift irrigation, except for a few weeks in the beginning, is saved. The requisites for a successful planting are (a) a high-level wetland that drains easily, (b) a well in its centre, and a *mhote* or *picotah* arrangement to lift the water and (c) acting under the advice of a Demonstrator, instead of playing off one's bat. The initial outlay consists in digging and constructing a well for every 6 or 7 acres. The *mhote* arrangement is better, for it does away with human labour to a great extent, and the bullocks can be worked for ploughing other lands, carting manure and produce etc.

I have not kept a costing account. The labour employed was of men engaged in paddy cultivation on the same farm. The cost of seed, manure and labour

came up to Rs. 20. As the effort was the first of its kind, the cost might be 25% more than was necessary. About 3000 canes were the outturn. The cultivation was not intensive. Almost every farmer, big or small, could easily attempt this venture on a small scale in the first instance, and observing the results, expand the cultivation.

The growing of paddy and paddy alone is monotonous work and drab, and this accounts for the indifferent cultivation one sees everywhere. There is a friend of mine, who, with an oil engine installation, grows sugarcane and plantains, and it is paying him.

Crop & Trade Reports.

Castor—First or Final Report—Madras—1935. The average of the areas under castor in the Madras Presidency during the five years ending 1933—'34, has represented 20 per cent of the total area under castor in India. The area under castor in the Madras Presidency up to the 25th November 1935 is estimated at 261,700 acres. When compared with the area of 289.200 acres estimated for the corresponding period of last year, it reveals a decrease of 9 5 per cent. The estimate for last year was above the actual area of 278,131 acres by about 4 per cent. The decrease is general outside Ganjam, Vizagapatam, East Godavari, Bellary, Chingleput, North Arcot, Trichinopoly, Tanjore, Ramnad, Tinnevelly and the West Coast. The yield is expected to be 99 per cent of the normal as against 79 per cent in the previous year according to the season and crop report. On this basis, the yield is estimated at 25,800 tons as against 26,100 tons estimated for the corresponding period of last year and 22,780 tons estimated in the season and crop report of last year. The wholesale price of Castor seed per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of November 1935, was Rs 6 in Berhampore, Rs. 5—5—0 in Vizianagaram, Rs. 5—4—0 in Madura, Rs. 5—1—0 in Cocanada and Rs. 5 in Vizagapatam, Ellore, Bezwada and Guntur and ranged from Rs. 4—2—0 to Rs. 4—15—0 in the other markets. When compared with the prices reported at the corresponding date of last year, these prices reveal a rise of 33 per cent in Vizagapatam, Vizianagaram and Ellore, 31 per cent in Guntur, 30 per cent in Vellore, 16 per cent in Salem, and 7 to 10 per cent in the other markets.

Paddy—Intermediate report—Madras—1935—36. The main crop of paddy has been harvested in parts of the Circars, the Deccan and the West Coast. The yield is reported to be slightly above normal in South Canara, normal in Kistna, the Deccan and Malabar and below normal in the other districts. The main crop of paddy under rainfed tanks in parts of the Nellore district has been affected by drought to some extent. In Tanjore, the early samba varieties have been adversely affected by the high winds in November and rains in December and in parts of the districts of Trichinopoly, Ramnad and Tinnevelly, the crop has been affected a little by insects. The condition of the crop is fairly satisfactory in the other districts. The wholesale price of paddy per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of December 1935 was Rs. 3—2—0 in Cuddapah, Rs. 3—1—0 in Salem, Rs. 2—13—0 in Nellore, Rs. 2—12—0 in Vellore, Erode. Trichinopoly and Madura, Rs. 2—11—0 in Vizianagaram, Rs. 2—10—0 in Nandyal Rs. 2—8—0 in Berhampore, Rs 2—6—0 in Tinnevelly and ranged from Rs. 2—1—0 to Rs 2—5—0 in the other markets. When compared with the prices reported in the previous month, these prices are stationary in Vizagapatam, Vizianagaram, Nandyal, Cuddapah, Vellore, Erode, Trichinopoly, Kumbakonam and Tinnevelly; they have risen by eight per cent in Cuddalore, two per cent in Cocanada and Guntur and by one per cent in Ellore and are lower by 8 per cent in Madura, 7 per cent in Negapatam, 5 per cent in Rajahmundry, 4 per cent in Masulipatam and by one to 2 per cent in the other markets.

Cotton—Intermediate Report—Madras—1935-36. The Cocanadas cotton in parts of Guntur and Nellore and the dry cotton in the Vizagapatam district have been affected by drought to some extent. The crop has been affected with fungus disease in Cuddapah owing to cloudy weather and flowers are falling. The condition of the crop is fairly satisfactory in the other districts. The wholesale price of cotton lint per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 20—7—0 for Cocanadas, Rs. 24—14—0 for Northerns, Rs. 19—8—0 for (early crop) Westerns, Rs. 28—2—0 for Cambodia, Rs. 26—11—0 for Coimbatore-Karunganni, Rs. 24—7—0 for Tinnevelley-Karunganni, Rs 23—12—0 for Tinnevellies and Rs. 24—2—0 for Nadam. When compared with the prices in the previous month, these prices reveal a rise of six per cent in the case of Northerns and one per cent in the case of Westerns; they have fallen by two per cent in the case of Cambodia, Coimbatore-Karunganni and Nadam, five per cent in the case of Tinnevellies and six per cent in the case of Tinnevelly-Karunganni. The price of Cocanadas is stationary.

Pepper—Final Report—Madras—1935 The area under pepper in 1935 in the districts of Malabar and South Canara is estimated at 90,500 acres in Malabar 8,500 acres in South Kanara as against the final area of 85,164 acres in Malabar and 7,581 acres in South Kanara in the previous year. The condition of the crop is fair. The crop is getting ready for harvest. The seasonal factor is estimated to be 90 per cent in each district as against 100 per cent in the previous year. On this basis, the yield is estimated at 12,200 tons for Malabar and 1,150 tons for South Kanara as against 13,300 tons for Malabar and 1,280 tons for South Kanara estimated in the previous year. The wholesale price of pepper per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 15—12—0 in Calicut, Rs. 14—1—0 in Cochin. Rs. 13—1—0 in Tellicherry and Rs 14—8—0 in Mangalore. When compared with the prices reported in August 1935, these prices have fallen by about 14 per cent in Calicut, 13 per cent in Tellicherry and Mangalore and 12 per cent in Cochin.

Gingelly—Third Report Madras—1935—36. The average of the areas under gingelly in the Madras Presidency during the five years ending 1933—34 has represented 12 per cent of the total area under gingelly in India. The area sown with gingelly up to the 25th December 1935 is estimated at 500,600 acres. When compared with the area of 462,600 acres estimated for the corresponding period of last year, it reveals an increase of 8·2 per cent. The increase in area is general outside Vizagapatam, East Godavari, South Arcot, North Arcot, Salem and South Kanara. The increase is marked in Trichinopoly (18,500 acres). There has been a marked decrease in Salem (16,700 acres). The main crop has been harvested except in the south where the harvest is in progress. The crop suffered from drought to some extent and the yield is reported to be below normal except in East Godavari, West Godavari, Kistna, the Deccan, Salem, Ramnad and South Kanara. The seasonal factor for the Presidency works out to 92 per cent of the aver ge as against 84 per cent for the corresponding period of last year. On this basis, the yield is estimated at 61,700 tons as against 53,300 tons for the corresponding period of last year, an increase of about 16 per cent.

Ginger—Final Report—Madras—1935. The area under ginger in 1935 is estimated at 11,800 acres in Malabar as against the actual area of 11,733 acres in the previous year. The seasonal factor is estimated at 80 per cent of the normal as against 70 per cent in the previous year. On this basis, the crop is expected to yield 3,370 tons of dry ginger as against 2,750 tons in the previous year. The wholesale price of dry ginger at Calicut towards the close of December 1935 was Rs. 27—10—0 per imperial maund of 82-2/7 lb. When compared with the price reported towards the close of August 1935, there has been a rise of 4·4 per cent.

College News & Notes.

Students' Corner. The College reopened after the christmas vacation on 6th January. The second year students assembled at Anakapalle for an agricultural tour in the Circars, under the charge of Messrs. K. Raghavachari, Lecturer in Agriculture, V. Suryanaraya, Assistant Lecturer in Agriculture, and B. Suryanârayana Rao, Assistant Lecturer in Entomology. They returned to head quarters on the 20th.

With one class away, there was not much of athletics, only cricket being played. The first and third year students played 2 matches on the 13th and the 18th the third years winning on both occasions, although with both the teams putting forth their best, the issue was kept in suspense till almost the very last over bowled. Another exciting match was the holiday match on Pongal day between students and officers, which the former with 126 runs, won by a narrow margin of 3 runs.

Weather. Rather unhealthy weather with marked fluctuations—hot during the day and very chill at nigats—prevails during the month, and chicken-pox, measles etc. are prevalent on the estate.

A Royal visit. H. H. The Maharajah of Cochin, accompanied by the Dewan and the Collector of Coimbatore, visited the Research Institute on the afternoon of the 17th. Mr. R. C. Broadfoot and Mr. M. C. Cherian, took the Royal visitor round the various sections, where His Highness was much impressed with all that he was shown.

Other visitors. Mr. C. Ramalinga Reddy, M. L. C., who had been to Coimbatore in connection with the Golden Jubilee Celebrations at the Students' Literary Association, visited the College on the afternoon of the 7th and was taken round the various sections by the Principal.

Pongal celebrations. As usual, *Mattu Pongal* was celebrated with great enthusiasm at the Central Farm and the several Breeding Stations. The Animal Nutrition section, where the number of animals under experiment has been growing was another of the units that celebrated the festival this year.

Obituary. We regret to record with great sorrow the death due to heart failure of Mr. K. D. Dharmarajan student of the second year at Anakapalle. The fact that the death occurred during the tour of the students and suddenly, adds much to the poignancy and we offer our heart-felt condolences to the members of the bereaved family.

The King's death. The melancholy news of the King's death was received, by the Estate residents, with great sorrow. The Officers' Club and the Government Servants' Co-operative Society remained closed for 2 days. A resolution of condolence was passed at a meeting held under the joint auspices of the Madras Agricultural Students' Union, the Association of Upper Subordinates, the Indian Officers' Association, the Officers' club, the Ladies' club, the Association of Economic Biologists and the Fieldmans' Association, on the 24th inst., Principal, Mr. R. C. Broadfoot presiding. The Union sent a message of condolence to the members of the Royal family through His Excellency the Viceroy.

Weather Review (DECEMBER 1935).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	0	−0·8	42·7	South	Negapatam	18·7	+7·3	73·5
	Berhampore*	0	0	34·1		Aduthurai *	16·8	+8·3	49·9
	Calingapatam	0	−0·6	29·3		Madura	1·2	−0·6	26·2
	Vizagapatam	0	−0·7	18·6		Pamban	4·4	−3·1	37·8
	Anakapalli*	0	−0·2	22·2		Koilpatti *	1·8	−0·9	20·4
	Samalkota*	0	−0·3	36·3		Palamkottah	2·9	−1·2	30·1
	Maruteru*	0	−0·6	33·6					
	Cocanada	0	−0·9	24·9					
	Masulipatam	0	−0·9	32·7	West	Trivandrum	3·0	+0·3	59·6
	Guntur *	0	−0·1	29·8	Coast	Cochin	0·6	−1·1	83·3
						Calicut	0·3	−0·8	102·8
Ceded	Kurnool	0	−0·3	26·1		Pattambi *	0	−1·2	78·8
Dists.	Nandyal *	0·1	−0·3	31·5		Taliparamba *	0·2	−0 8	129·0
	Hagari *	0	−0·2	22·0		Kasargode *	0	−1·2	145·6
	Bellary	0	−0·1	20·0		Nileshwar*	0 1	−0·8	127·5
	Anantapur	0	—	21·0		Mangalore	0·6	+0·1	122·8
	Cuddapah	0·2	−0·7	33·0					
Carnatic	Nellore	0·5	−2·7	24·9	Mysore	Chitaldrug	0	−0·3	25·8
	Madras	2·3	−3·4	40·3	and	Mysore	0·2	−0·2	39·6
	Palur *	8·7	+0·2	46·2	Coorg	Mercara	0·2	−0·5	121·2
	Palakuppam *	4·8	−0·4	34·4					
	Cuddalore	12·9	+5·7	46·5					
						Kodaikanal	6·1	+2·5	79·1
Central	Vellore	2·1	−0·6	40·3	Hills.	Coonoor	4·4	—	53·6
	Hosur cattle					Ootacamund *	2·4	−2·4	38·1
	farm*					Nanjanad *	1·8	−0·2	45·2
	Salem	0·4	−0·6	31·0					
	Coimbatore	0·6	−0·5	15·2					
	Coimbatore Res. Inst. *	0·8	−1·5	—					
	Trichinopoly	4·5	+2·0	38·0					

* Meteorological Stations of the Madras Agricultural Department.

Summary of Weather Conditions, December 1935.

Dry weather prevailed over the Peninsula in the first week. A depression formed in the Andaman Sea on the 5th instant but weakened the next day to a trough of low pressure, which persisted till the 9th. This did not affect the weather in the Peninsula, but caused widespread rain in Tenasserim. The north-east monsoon strengthened in south Madras on the 18th and there was widespread rain there from the 18th onwards. A low pressure wave passed westwards across Ceylon on the 20th causing general rain in the south-east Madras. Associated with a strengthening of the north-east monsoon in the South-West Bay of Bengal there was generally heavy rainfall in south Madras on the 23rd, 24th, 25th and 26th instants.

Rainfall was locally in excess at a few stations in the south and in defect elsewhere.

Chief falls reported were :—

Negapatam	6·0″ on the 18th.
Cuddalore	4·3″ „ „

Negapatam	5·7'' on the 20th.
Cuddalore	2·9" „ 27th.
and Aduturai	5·6"

Weather Report for the Research Institute Observatory.

Report No. 12/35.

Absolute Maximum in shade	88·8°F
Absolute Minimum in shade	58 3°F
Mean maximum in shade	84 9°F
Departure from normal	0
Mean Minimum in shade	65 8°F
Departure from normal	0
Total Rainfall	0·84"
Departure from normal	1·49"
Heaviest fall in 24 hours	0 32 (Recorded on 25-12-35.)
Total number of rainy days	4
Mean daily wind velocity	2·6 M. P. H.
Mean humidity at 8 hours	7·51 %
Departure from normal	4·6 %
Total hour of Bright Sunshine.	213 5 hours.
Mean daily Hours of Bright sunshine	6·9 hours.

Summary. Rainfall was in large defect. Most of the rainfall was received between the 24th and 28th instants in small showers. Temperatures were normal Lowest minimum recorded was 58·3°F on the 1st December 1935.

A. S. R. & D. V. K.

Departmental Notifications.

Leave. Mr. S. Ramachandran, A. D. VIII Circle. extension of l. a. p. for 2 months. Mr. M. Eggiaswami Ayyar, A. D. IV Circle extension of l. a. p. on M. C. for 10 days in continuation of 8 months' l. a. p. already granted.

Transfer. Mr. V. Chidambaram Pillai, A. D. Nanguneri as F. M. A. R. S. Koilpatti, Mr. J. S. C. Antony, F. M. A. R. S. Koilpatti, as A. D., Nanguneri. Mr. E. T. Verghese, Asst. to G. A. C. transferred to officiate as Asst. Lecturer in Chemistry Vice Dr. C. Narasimhacharya deputed for foreign service. Mr. K. H. Subrahmania Ayyar, A. D. Annur to be on van duty in Salem Dist. till 16—2—36, after which to be A. D., Erode. Mr. P. K. Nambiar, A. D., Erode to be A. D. Pollachi.

Manager's Notice.

Subscribers and Members whose subscription expires by December 1935, are kindly requested to remit their subscription before the first week of February at the latest.

WANTED MARKET GARDENER.

Tamil Speaking Christian. Must be capable of opening up a garden and teaching young men. State salary required to George F. Champion, VALAVANTHINADU, Namakal Taluk.

Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

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Editorial.

Weather and Plant diseases. It has been recognized from the earliest times that weather factors play an important part in the incidence and spread of diseases and pests of plants. Indeed, till the discovery of micro organisms, in the middle of the nineteenth century, the occurence of such diseases as blight, mildew etc. was attributed solely to adverse weather conditions. The discovery of pathogenic bacteria and fungi led the scientists of the period to err on the other extreme, and lay too much emphasis on the causal organism, under-estimating the influence of weather factors. In recent times however, the intimate relationship that exists between weather and disease is again realised, and increasing attention is being devoted to research on what has been termed as the phenological aspect of plant diseases, and during the last fifteen years, a considerable volume of literature has been gathering round the subject. The conference of Empire Meteorologists, which met in 1929, focussed the attention of both meteorologists, and plant pathologists, on the need for intensive work in this direction, and emphasised the necessity for co-ordinated endeavour in their approach to the problem. In several countries as for example France, Germany and Italy, a system of forecasting diseases and pests has been organized by the Governments with a view to warn the farmers, though it must be admitted, that even in these countries they are yet a long way off in either correctly

forecasting the intensity of the disease, or forestalling it when its incidence is a certainty.

In India, the importance of the study of this subject cannot be over estimated. The periodical recurrence of a number of fungoid diseases, and insect pests on an epidemic scale, is laying a heavy toll on the cultivators and despite the great progress that has been attained during the last twenty-five years, in respect of our knowledge regarding these plant diseases and pests, very little organised work has been done on the phenological aspect. It is no doubt true that in the course of the investigations on plant diseases and pests, much valuable data, throwing light on the problem have been collected, but, these have been more or less of an isolated nature, and much work has yet to be done before the data can be analysed and correlated.

The reasons for the comparative neglect of this aspect are not far to seek. The science of plant pathology is itself in its infancy, in India, and the Mycologists and Entomologists of the Agricultural Departments (who are the only workers) had perforce, in the initial stages, to engage themselves with problems of immediate moment, and those which will yield results in a short period. Their attention was naturally directed towards the aetiological aspect of diseases, with a view to finding out cheap and effective remedial measures. The complex and uncertain nature of the phenology of diseases, which involves not only intensive laboratory study but also observations in the field carried over a large number of years, the absence of well equipped meteorological stations, except in a few centres; and the absence of contact between the meteorologists and agricultural officers have also been additional deterrant factors in the pursuit of the subject. To the above may also be added the general paucity of workers dealing with plant pathology and agricultural entomology. The study of these subjects has been almost entirely confined to the several Agricultural Departments, the Universities in India, except perhaps until very recently, not having directed their attention to it so far.

With the advent of the Imperial Council of Agricultural Research, however, there are signs that we are progressing towards a better state of affairs, and it is hoped that before long our knowledge regarding the relationship of weather to the more important diseases and pests of crops will have increased considerably.

In South India among the more important diseases and pests, a few occur periodically, and their outbreak in an epidemic scale would appear to be intimately connected with weather conditions. The *mahali* disease of arecanut though appearing year after year, with regularity varies with regard to its intensity and consequent damage to the crops. This has been attributed to changing monsoon conditions. The blast disease of paddy caused by *Piricularia oryzae* is also

intimately connected with the weather conditions that prevail throughout the duration of the crop. The mildews of various crops and the smuts are also in the same category. Among the insectpests, the swarming caterpillar (*Spodopteria mauritia.*) of paddy and the stem borer (*Schonoebius incertullus*) are dependent to a great extent, on weather conditions for their spread.

It therefore seems to us that attention devoted towards this aspect will be worthwhile, and we would suggest that an accurate record of the occurrence of plant diseases and pests be maintained in every agricultural station, so that with the accumulation of sufficient data it might be possible in future years within the limited means at our disposal, to correlate them with the weather data, and arrive at some conclusions which are bound to be useful to the farmers.

* * * *

Jubilee Celebrations. Our readers will be glad to learn that the Union has approached His Excellency Lord Erskine with a request to honour them by inaugurating the celebrations, of the Diamond Jubilee of the introduction of Agricultural Education in India, in July this year. The Hon. Mr. P. T. Rajan, Minister for Development has been requested to preside over the conference. It is hoped that the celebrations will be a great success.

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Mr. T. Lakshman Rao, Assistant Agricultural Chemist retired from service last December and a short sketch of his career will be found elsewhere in this issue.

DEVELOPMENTAL STUDIES IN RICE—I *

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Introduction:— The aim of the plant breeder is to develop a most promising form with the yield as the ultimate aim. The carrying out of comparative yield trials with different rice varieties or with different strains of a variety of rice is always an important work of the rice breeder. The methods of conducting such trials have received considerable attention and have been brought to a high state of refinement due chiefly to the work of the Statisticians in this branch of agricultural science. Though such trials bring out yield differences between varieties or strains, the causes of such differences are still little understood and have not received adequate attention. Agriculturally, yield may be a single conception as so much of produce per unit area cultivated. Biologically, however, yield is a complex, an end result or integration of the vital activities of the plant which depend on the genetic constitution of the plant and the environment on which it is nurtured. The internal basic physico-chemical characters constituting the vital activities of the plant lead up to the manifestation of external yield characters as growth, tillering, ear size, etc.

The results of the outstanding work regarding the study of the fundamentals underlying yield in cereals by Prof. Engledow of Cambridge and his associates have been published in the several volumes of Journal of Agricultural Science. The aim of this study has been to understand the reasons for the difference in yield of the cereals as expressed in the morphological development of the plant. This knowledge is essential to judge definitely under what conditions a particular form can be grown successfully. The knowledge about the adaptations of varieties to different conditions is mostly traditional based on long experience of practical cultivators. Although one may know that certain forms of rice are more adapted to certain conditions, very little is known about the reactions which the plants exhibit when grown under such conditions. The need for the study of the development of the plant in all its phases and its relation to yield is therefore emphasised. Tillering, both a morphological and a physiological character, common to all cereals is a very important developmental phase of the rice plant. Any favourable treatment to which the plant may be subjected brings about quick response in the increase in the number of culms. Besides soil, some of the agricultural practices that influence tillering are the time of planting, spacing, manuring etc. That tillering apart from its behaviour due to

* Paper read at Indian Science Congress 1935.

environment is a varietal character is well brought out from the study of this character in the large number of varieties—all pure lines—grown at the Paddy Breeding Station, Coimbatore, year after year. Some are inherently poor in the number of tillers they produce while others are more prolific. Since effective tillering i.e., the number of ears per plant is definitely related to yield its study becomes important. Besides tillering, the other factors that contribute to yield in rice are the size of the ear, its density and the size of the individual grain in the ear. The present article treats about the results of studies on the development of tillers, and the size of ear and their relation to final yields in a few pure lines. The effect brought out by factors like changes in the environment, manuring etc, on these developmental phases, and consequently the yield, was investigated with one or two pure lines over two or three seasons and these are dealt with in section II.

Tillering. *Discussion of literature.* Considerable work has been done in cereals in general and on rice in particular on this important attribute of the plant. In a majority of cases the attempt has been to bring out the relationship between tillering and the environmental conditions under which the plant grows. Thompstone (1915) in Burma has found that the high yielding strains have been found among those whose tillering mean is but a little higher than that of the original type while some of the strains with high tillering mean have yielded but comparatively poor outturns of grain. He concludes that long durationed varieties, generally, tiller more than the short durationed ones. Summers (1921) in Ceylon had evidence to show that among the important Ceylon rices short duration paddies possessed a greater tillering capacity in general than those of longer periods of maturation. Ramiah (1927) writing on the growth phases of rice varieties observed that long duration varieties as a rule produced a larger number of tillers than short duration varieties. Saravayya (1932) at Maruteru has found that varieties that finish their tillering in the early stages yield better than those which prolong their tillering phase. Joshi (1923) gathered data regarding the influence of time of planting, age of seedlings, planting of singles or bunches, application of manures, spacing etc, on the tillering and finally concluded that tillering was hereditary in character and that while phosphatic and potassic manures had no influence on tillering, nitrogenous manures did have, and that with the increase in the number of tillers artificially induced, there was a large percentage of loss of late tillers with reduction in the size of the ear. Hector (1921) finds that spacing has a great influence on the number of tillers per plant and the number of grains per tiller but no effect on the weight of the individual grain. Jacobson (1916) differed on this point in his work on the "Correlative characters of the paddy plant", and he was supported by Thompstone. He found that tillering of the individual plant was negatively correlated with the

number of grains per panicle and the size of grain. Dionisio Calvo (1927) and Rodrigo (1924) gathered data on the effect of spacing on tillering and yield, and came to the conclusion that the physiological expression of the tillering power of the rice plant was made greater by wider spacing between the hills Inagaki of Japan (1897) as far back as 1897-98 made some experiments on the effect of planting in singles, doubles, trebles, etc, on the total number of shoots per hill, and with the data, developed a mathematical way of estimating the possible number of shoots that would be developed with different number of seedlings per hole, if the shoots in one of them were known. It must be understood however, that in most of the available literature the tillering has been denoted by the number of final ears found at harvest. Engldow's work on cereals has more than emphasised the importance of studying the progress of tillering right from germination up to the time of harvest as it is only then that differences due to variety or environment can be evaluated.

Material and methods. Ten Coimbatore strains varying in duration from 150 to 180 days were all planted side by side with even spacing one foot by six inches under as uniform conditions as possible. Uniform blocks of 300 plants in each variety were chosen and care was taken to avoid plants near the b rders and uneven patches, plants damaged by insects, plants adjoining gaps. etc. The tillering of each of these 300 plants in every block was counted every week. Although for this study 300 plants were actually under observation it was later observed adopting different methods of sampling, that under very uniform conditions obtaining in the plots at the Breeding Station and with crop planted with seedlings of uniform growth, a population of even 50 plants was enough to study tillering. At each weekly count every tiller large enough to be seen i. e., after it has come out of the subtending leaf sheath was counted and no attempt was made to differentiate the size of the individual tillers. As towards the end of the tillering phase death of tillers also commences, count of dead and living tillers at each stage was made note of and to avoid confusion the dead tillers were actually removed from the plants at the time of tiller counts.

General Observations. Unlike in other cereals, irrigated ragi (*Elusine coracana*) being an exception, rice is invariably transplanted i. e., the seed is first sown in the seed-beds, and after the lapse of a period, which would vary according to the life duration of the variety of rice, the seedlings are pulled out and transplanted in open fields puddled and levelled. Though the direct sowing of the seed in the fields is also prevalent in certain tracts such practice is never adopted in tracts where conditions and facilities for transplanting are available. The seedlings after transplantation take some time, 6 to 10 days, to revive as indicated by the casting off of old leaves and production of

the new. Although certain conditions like good tilth in the soil, good vigorous seedlings, cloudy weather and light showers at planting, all favour quick establishment of the plants, observations at Coimbatore have shown that the rapidity of establishment is a varietal character. It must also be understood that the roots that remain with the seedlings at the time of transplanting do not function. It is only the fresh roots that start from the nodes after planting that are of help to the plant. In an experiment carried out at the Paddy Breeding Station, Coimbatore, varying degrees of pruning the roots at the time of planting including ones where the roots were all completely removed were put under comparison and it showed, that the pruning had no effect on the subsequent growth and development of the plant.

The production of tillers or side shoots often starts even in the seed-beds particularly on the borders of the beds where the plants have more space and access to light. Ordinarily, side shoots do not arise from the axils of the two scale like structures at the base of the young seedling. By following the course of development of a side tiller, it will be seen that in very early stages the tiller is completely encased by a pinkish while scaly leaf. As the tiller grows, the scaly leaf also grows with it to a fair size. By careful observation, it is possible, even in grown up plants, to differentiate between a primary and secondary tiller, by the position of this scale. Normally a bud is borne in the axil of each leaf and thus a shoot may grow out from each bud. But actually tiller production is restricted to the nodes near the surface of the soil. The tillering zone is restricted to half to one inch in length along the main axis and situated about one to two inches below ground level. The internodes at this zone are all very much suppressed. If planting is done rather deep the bottom most internode elongates up to about one inch below ground level and then the tillering starts. When the crop is planted late, or when it lodges flat during later stages, shoots from the higher nodes may also develop but they are rarely ear bearers. Ratooning is nothing but the development into tillers of dormant buds at nodes below and above ground level of the stubble left over. There are certain types in the Coimbatore varietal collections which have a predisposition to tiller at higher nodes even under normal field conditions. But here the process may probably be rightly called branching rather than tillering and such branches do mature ears. This habit in certain rices has been recorded by Jones (1925)

Formation of tillers. The tillering starts from below and as they are being formed progressively along the main axis, some of the early tillers might start producing secondary tillers in their turn. When there is a large amount of tillering there appears to be a definite relation between these secondary and tertiary tillers (tillers produced by secondary tillers) and the total number as the data in

Table I would indicate. The secondary tillers T_1, T_2, T_3,......do not produce tertiary tillers unless the total number of tillers for the plant exceeds ten or twelve.

Table No. I.

Tiller Distribution. *Variety—GEB. 24.*

Total No. of tillers per plant including the main-shoot.	Number of side tillers produced by											
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_{1-1}	T_{2-1}	T_{3-1}
3	2	...	...	...	...	...	...	...	...	...	...	...
4	3	...	...	...	...	...	...	...	...	...	...	...
5	4	...	...	...	...	...	...	...	...	...	...	...
6	4	1	...	...	...	...	...	...	...	...	...	...
7	4	1	1	...	...	...	...	...	...	...	...	...
8	4	2	1	...	...	...	...	...	...	...	...	...
9	5	2	1	...	...	...	...	...	...	...	...	...
10	5	2	2	...	...	...	...	...	...	...	...	...
11	5	3	2	...	...	...	...	...	...	...	...	...
12	5	3	2	1	...	...	...	...	...	...	...	...
13	5	4	2	1	...	...	...	...	...	...	...	...
14	5	4	2	1	...	...	...	...	...	1	...	...
15	5	4	3	1	...	...	...	...	...	1	...	...
16	6	4	3	1	...	...	...	...	...	1	...	...
17	6	4	3	1	1	...	...	...	...	1	...	...
18	6	4	3	1	1	...	...	...	...	1	1	...
19	6	4	3	2	1	...	...	...	...	1	1	...
20	6	4	4	2	1	...	..	...	...	1	1	...
25	7	5	4	3	2	...	...	...	...	2	1	...
32	8	5	5	3	3	2	2	...	...	2	1	...

The arrangement of the tillers in every case is alternate. While it may appear difficult to trace the chronological relationship of the several tillers in a plant directly in the field it can be made out by removing the plants and dissecting the parts. The course of tiller formation appears to be identical in all the strains studied (Table II), there being no varietal difference in the mode of tillering or in the distribution of the tillers in the plant. Summers (1921) believes that secondary or tertiary tillers appear in two separate phases. As a matter of fact, after a certain stage, primary, secondary, and even the tertiary tillers begin to produce tillers all at the same time. Under field conditions, however, the tiller distribution is not so absolutely systematical. Some buds fail to develop and others die after some development. During advanced stages of growth, crowding occurs with the result that the process of tillering with respect to one or more side tillers comes to a stand still while others more favourably situated continue to do so.

Tillering commences two weeks after transplanting and goes on rapidly for about four to five weeks thereafter. The active period of

tillering is a varietal character mainly dependent on the duration of the variety. This period may be definitely less, 3 to 4 weeks only in a variety of four months and below—Ramiah (1927). Apart from the varietal characteristic, abnormal conditions like too much spacing, late planting, excess of nitrogenous manures in the soil, insect attack like the borer, sometimes cause the normally dormant buds to get active and produce tillers and thus prolong the vegetative phase. Excess of water supply to the fields either artificially or due to excessive precipitation, may accentuate a fresh tillering phase resulting in a few small tillers late in the season. Such prolonged tillering naturally leads to a high percentage of abortive tillers, uneven heading and unsatisfactory harvest. The contribution of such later tillers to harvest is only straw.

Reduction in Tillering. When once the tillering phase has reached the maximum under normal conditions in spite of the ideal conditions for active growth being present, some of the late formed tillers start dying off. Probably the mother tillers cut off all supplies of nutrition to such late tillers and as these late tillers do not develop any root system to lead an independent existence they naturally die. In all probability the primary stem of rice under transplanted conditions acts as a host for the subsidiary daughter tillers for some time only. All the late and undesirable tillers are thus eliminated by the time the plant passes into the reproductive phase. This reduction in tillering is almost the same in all the varieties studied as will be apparent from the data in Table II. The final percentage of ears to the maximum

Table No. II

Tiller Production and Reduction.

(as percentages of the maximum number of tillers produced per plant).

Date of observation (Number of days after planting)	19	26	34	40	47	55	61	68	76	90	98	104	112
Variety						Percentage.							
GEB. 24	...	44	76	98	100	98	87	82	74	73	71	...	...
Co. 2	37	66	93	97	100	92	91	91	73	69	...	68	...
Co. 3	36	70	95	98	100	92	90	87	77	...	68	...	67
Co. 5	44	75	95	98	100	95	90	85	73	...	65	...	64
Co. 6	36	60	95	97	100	95	94	92	83	...	71	68	67
Co. 4	39	61	88	94	100	93	91	85	73	...	59	56	55

tillering produced varies in the different varieties but the percentage of functional tillers to the total in the different tiller classes is practically the same in all the varieties (Table III). The proportion of functional tillers is found to be definitely less in a late variety like Co. 4.

Tiller production and yield. The relationship between yield and tillering is interesting. In wheat the increase in tillering is associated

with greater yield and greater tiller production is a sign of greater vigour is evident from the yield per ear gradually increasing as the

Table No. III.

Percentage of Functional Tillers in the Different Tiller Classes.

Variety.	Number of tillers per plant.															Co-efficient of correlation (r) of tiller production to ear formation.
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Co. 1	...	84	87	89	87	87	86	85	78	...	...	...	...	...	...	0·81±0·014
Co. 2	...	...	70	66	69	71	65	70	68	67	70	...	...	...	...	0·88±0·008
Co. 3	...	...	...	...	73	69	69	72	66	69	67	69	69	...	...	0·83±0·013
Co. 4	...	...	...	...	...	...*	54	62	56	60	59	51	51	52	54	0·71±0·022
Co. 5	...	...	...	...	66	67	67	68	65	61	68	63	66	64	...	0·86±0·012
Co. 6	...	...	76	76	70	67	66	67	63	...	...	...	...	...	...	0·72±0·021
Co. 7	92	88	86	84	82	80	76	82	...	...	...	...	...	...	...	0·72±0·019

number of tillers increase in the plants. In rice, in several of the varieties examined, increase in the number of functional tillers is directly proportional to the yield per plant (Table IV).

Table No. IV.

Yield of grain per plant in grams.

Variety.	No. of ears per plant.											
	3	4	5	6	7	8	9	10	11	12	13	14
GEB. 24	...	...	6·2	9·4	9·9	10·8	13·1	13·3	15·6	15·4	...	...
Co. 1	3·8	5·2	6·9	7·9	9·5	11·0	12·6	15·8	...	...	...	...
Co. 2	...	7·1	8·0	9·5	11·3	11·8	14·0	16·4	...	...	...	...
Co. 3	...	...	9·1	10·5	12·6	14·2	16·7	18·1	20·4	...	...	...
Co. 4	...	8·2	10·2	13·0	13·4	14·6	15·8	17·1	...	...	...	...
Co. 5	...	9·0	12·0	13·7	15·1	17·0	20·8	21·5	23·4	26·4	...	...
Co. 6	6·4	8·1	9·4	11·4	13·2	16·3	16·6	...	...	...	...	...
Co. 7	5·6	7·4	10·3	12·6	14·8	16·6	21·1	...	...	...	...	...

The relationship is more or less linear. In the case of the very late variety like Co. 4, the yield per plant does not increase in the same proportion as the increase in number of tillers. As regards weight of grain and the yield per ear there is not much difference in the plants with different number of ears for several of the varieties studied.

Table No. V. A

Yield of grain per ear in grams.

Variety.	Number of ears per plant.											
	3	4	5	6	7	8	9	10	11	12	13	14
GEB. 24	...	...	1·23	1·57	1·41	1·35	1·46	1·33	1·42	1·28	...	...
Co. 1	1·25	1·31	1·37	1·31	1·35	1·38	1·40	1·58	...	...	...	...
Co. 2	...	1·77	1·60	1·59	1·62	1·48	1·55	1·64	...	...	...	...
Co. 3	...	...	1·81	1·75	1·80	1·77	1·85	1·81	1·85	...	...	...
Co. 4	...	2·04	2·03	2·16	1·92	1·82	1·76	1·71	...	...	...	...
Co. 5	...	2·24	2·39	2·29	2·16	2·12	2·31	2·15	2·13	2·22	...	...
Co. 6	2·12	2·03	1·88	1·90	1·88	2·04	1·84	...	...	...	...	...
Co. 7	1·87	1·86	2·06	2·10	2·12	2·07	2·34	...	...	...	...	...

Table No. V. B

Weight of 100 Grains in Grams.

Variety.	Number of ears per plant.										
	3	4	5	6	7	8	9	10	11	12	13	14
GEB. 24	...	...	1·80	1·82	1·75	1·79	1·75	1·74	1·76	1·72	...	...
Co. 1	2·34	2·29	2·31	2·30	2·26	2·30	2·29	2·25	...	...	...	...
Co. 2	...	1·96	1·02	1·98	1·99	1·95	1·99	1·90	...	...	...	...
Co. 3	...	...	2·13	2·15	2·14	2·16	2·17	2·18	2·12	...	...	...
Co. 4	...	2·45	2·48	2·47	2·49	2·49	2·47	2·48	...	...	...	...
Co. 5	...	2·00	2·02	2·04	2·00	2·02	1·99	2·00	1·95	2·01	...	...
Co. 6	2·07	2·04	2·07	2·01	2·07	2·06	2·03	...	...	...	...	...
Co. 7	2·12	2·08	2·04	2·08	2·03	2·02	1·95	...	...	...	...	...

But in certain varieties like GEB. 24, Co. 1, Co. 7, etc., there is a perceptible, though slight, increase in the yield per ear as the number of ears per plant increases. It is possible that in these varieties increase in the number of ears, apart from its being a normal physiological activity of the plant is an indication of the plant's greater adaptability to respond to environmental changes which affect the production of ears. This is also evident from the fact that the percentage of functional tillers in plants with different number of tillers is almost the same in these particular varieties, whereas there is a slight and gradual drop in the percentage of functional tillers as the total number of tillers increase in the case of other varieties.

Critical period of tillering. The increase in tillering beyond a certain stage does not result in ears. If the ears formed follow the same order as the development of tillers, the plant produces enough tillers to result in ears even two to three weeks before the maximum tillering phase is reached. If we denote the particular stage in tillering where the number of tillers produced is equal to the number of ears formed as the 'critical period' all tillering beyond this period is a waste. As the data given in Table iii would show any increase in the number of tillers per plant leads to a corresponding increase in the number of ears. Since, however, the average yield per ear is almost the same in all the ear classes, an increase in the number of tillers per plant is bound to result in an increased yield per plant. Thus to enhance yield the attempt must be to so adjust the agronomic practices to enhance the rate of initial tiller production as much as possible. It is possible, however, that two varieties or two strains of a variety possessing the same average number of functional tillers per plant might differ in their yields and such a difference has to be accounted for by some yield attribute other than number of tillers. In such a case it is usually the ear size that is responsible for the difference as will be apparent from the below mentioned case. Two strains of *anaikomban*, a Tinnevelly variety have been compared for yield for a number of years and one of them

7567 always recorded a higher yield than the other strain. A comparative study of the developmental phases in the two strains showed that while the average number of ear bearing tillers per plant was not very different in the two, the average length of the ear and hence the number of grains per ear was always more in 7567 than in the other.

Table No. VI

Comparative yield attributes of Anaikomban strains.

	Anaikomban strains.	
	7567.	7566.
Maximum average tiller production per plant.	7·9	7·3
Average number of ears per plant.	4·8	4·4
Percentage of functional tillers.	61	60
Average yield per plant.	9·4 grams.	7·6 grams.
Average yield per ear.	1·96 "	1·73 "
Weight of 100 grain sample.	1·92 "	1·95 "
Average number of grains per ear.	102	89
Average length of panicle.	228·5 mm.	196·2 mm.
Number of grain per unit length 10 cm.	4·5	4·5

Individuality of tiller. To determine the individuality of the tillers and the relationship between the chronology of tillers and their contribution to yield a small subsidiary experiment was conducted. The aim was to find out the effect on yield by planting seedlings with three initial tillers, and also by removing the main, second or both the side tillers to elucidate the function of the respective tillers. Periodical counts of tillers were taken and the final yields were determined. The experiment was conducted with two varieties for two seasons. Though the yield of the plant was the highest where all the tillers were left in tact, the reduction in yield due to the removal of the second or third tiller was not very marked, but when the main tiller was removed the yield went down considerably. As regards the total number of tillers produced per plant it was highest where all the tillers were left in tact closely followed by the one where the third tiller alone was removed. Where the main tiller alone was left the tillering was the same as when the second and third tiller were both left. Where the second or third tiller alone was left to develop, the tillering was very poor and the yield was very much reduced. Incidentally it was also observed that wherever the main tiller by itself or in combination with others was left to develop, the plant flowered definitely a week earlier than plants where the main tiller had been removed. The results of this experiment definitely indicated the advantage of the lead of the main tiller in point of age and development towards the contribution to (a) total tiller production; (b) total yield and (c) earliness in flowering.

Development of the ear. Tillering in rice represents an aspect of vegetative phase while the rapid growth in height in later stages foretells the approach of the reproductive phase. Data gathered

during growth studies have yielded some useful information on the subject of ear formation. The factors at work that make a plant to stop vegetative growth and go on to the reproductive phase are not yet sufficiently understood. After a time, all the tillers in the rice plant produce their ear primordia in quick succession. Practically they all appear in the course of a week. Taking a medium duration variety like Co.2 or Co.3, which has an active tillering phase spread over four weeks, T_1, T_2, T_3 appear during the first week while the late ones, T_6, T_7, T_{1-3}, T_{2-3}, T_{3-1} etc. arise during the fourth week. The first batch will therefore have a lead of about 3 weeks to start with, but by the time they come to the primordial ear formation the interval gets reduced by about a week. The dates of ear emergence converge still further and the interval may get reduced to even four days. Thus the rate of development of the later formed tillers is much more rapid than in the earlier formed ones; the later the tiller formed the more rapid is its development.

The frequencies of tillering at each count when plotted give more or less a normal curve. In the later counts a few plants with the modal value for tillering at each count were pulled out and dissected to examine at what stage the ear primordia started forming, and what the connection was between tillering and ear formation. While the figures given in Table II show that the maximum tillering phase is reached almost at the same time for all the varieties under study, i.e., about six weeks after planting, the examination of primordial development showed that ear formation was independent of tillering and was mainly a varietal characteristic. Since no variety of rice under four and a half months in duration had been included in this study the observation was continued on a definitely early variety under four months, in the following season. The approximate time at which the ear primordia was formed was found to depend on the duration of the variety even in this case.

In *kar* Strain Co.10 which is definitely under four months in duration, the formation of the ear commences 15 days before the maximum tillering phase is reached. In varieties—GEB.24 and Co.1 which are 4½ months to 5 months in duration the ear formation begins a few days before the maximum tillering phase, and in varieties Co.2, Co.3 which are about 5½ months in duration the ear formation synchronises with the stage at which the tiller production is at its maximum. In late varieties of over six months' duration, like Co.4 and Co. 8, there is an interval of over three weeks between maximum tillering and the commencement of the ear formation. (Fig. I)

The time at which the ear formation commences has an important significance in yield investigations as the knowledge can be made use of to adjust one of the agronomic practices namely the application of a fertiliser as a top-dressing to the crop, to enhance the yield. The time of

application of the fertiliser in its relation to the size of the ear formed is dealt with in section II.

Among the varieties studied primordial ear formation commences 24 to 31 days before the date of emergence of the ear tip from the leaf sheath. The variation in this interval might probably have been wider if varieties earlier to and later than these under study had been included in the experiment. At the first instance the primordium looks like a fleshy globose protuberance measuring about $\frac{1}{8}$ to $\frac{1}{4}$ m.m. By the time it is $\frac{1}{2}$ m.m long, a few hemispherical excrescences are observed at the base, the number of which gradually increase in a short period. These bodies which represent the branches of the panicle, produce afterwards some spherical growths which are the rudiments of spikelets and these are laid down alternately on either side of the basal axis, (Fig. II). When it is 5 m. m. long tiny spikelets get differentiated at the top with stalks at their bases. The rings of hairs that are found along the rachis (in a well developed ear) become apparent even now. The process thereafter is elongation of the different parts of the panicle already formed, and formation of new spikelets at the base. The spikelets taken out of the middle of the ear of a tiller of the modal class for a particular week were measured for length and breadth. From the measurements made it can be stated that the elongation in length of spikelets in the middle and top of the ear is complete by the time the ear completes its elongation i. e., about 15—20 days after the formation of ear primordia. During the week preceeding emergence, the small spikelets at the base develop and assume normal size by the time the ear comes out of the sheath. Though the general trend of spikelet development is from top to bottom it is not quite so regular.

The ear ordinarily takes three days to completely emerge out of the leaf sheath after the appearance of its tip above the last leaf junction. Spikelets commence opening a day or two after they are exposed. Majority of spikelets in a panicle complete opening in six to eight days after they commence to do it, though it may take eight to ten days for all of them to open. The sequence of their opening is not very systematic though the general trend is from tip to base on the sub-spikes.

Rate of shoot-growth. Incidental to the study of tillering, observations on the growth rate were also recorded in the different varieties under study. The height of the rice plant in its earlier stages is mainly contributed by the length of its leaves. There is practically no elongation of the internode. As the tillers throw out new leaves the increase in height is due to the production of longer leaves in succession, with each leaf sheath projecting above the tip of the previous one. It has been recorded previously—Ramiah (1927) that in early varieties growth in height is continuous till they enter the reproductive phase while in

Fig. I.

Tillering and Commencement of Ear Formation

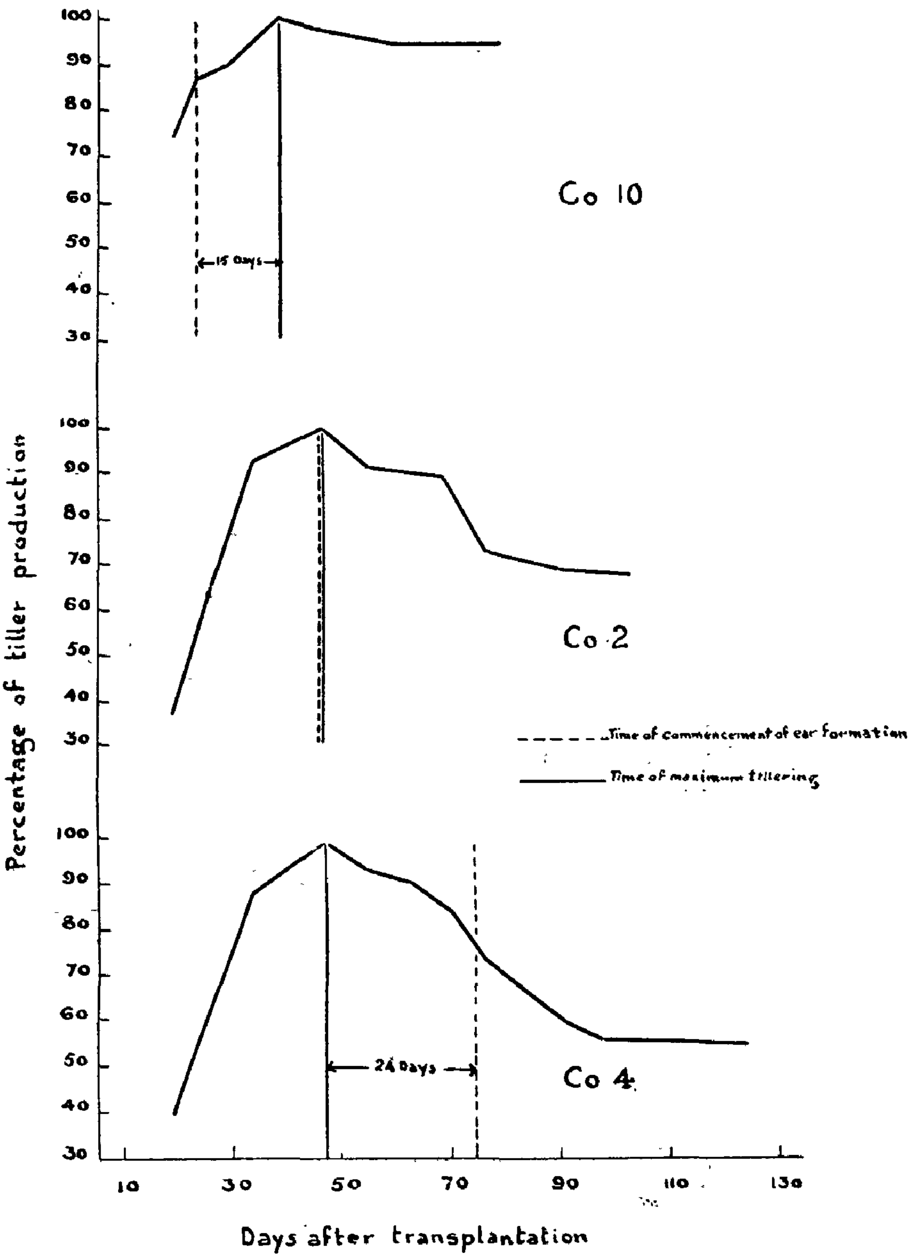
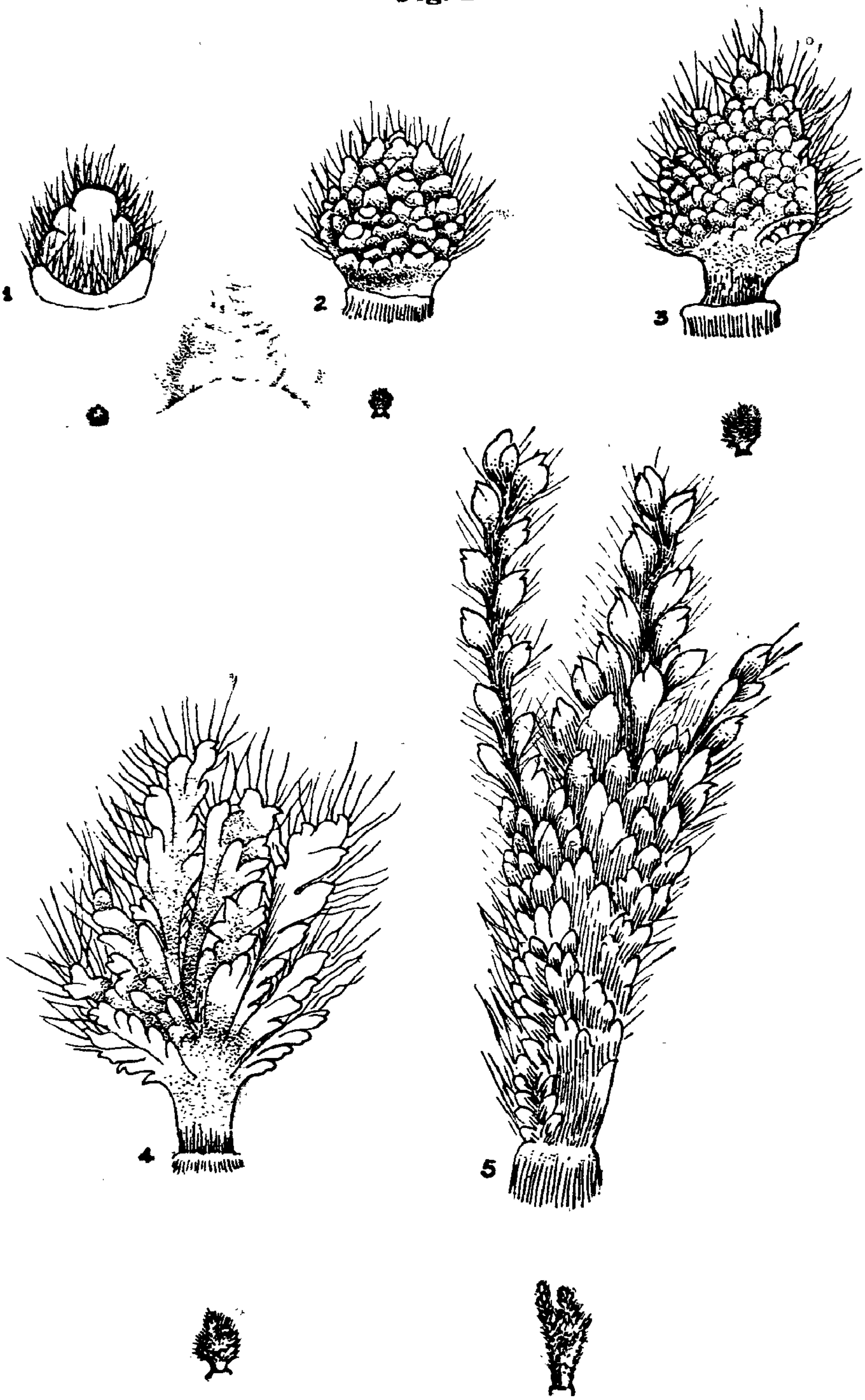


Fig. 2



Development of the Primordium (2 to 7 days.)

late varieties it is discontinuous. Nearly 90 per cent of the growth in height is attained during the month preceeding flowering and is largely contributed by the top-most internode, panicle and ear.

Table No. VII.

Lengths of Different Parts of a Paddy Shoot
(as percentages of the height of the shoot).

Variety.	Internodes (numbered from top down) i	ii	iii	iv	v	Peduncle.	Ear.	Height of shoot.	Remarks.
GEB. 24	21·4	16·2	11·0	3·5	1·2	28·0	18·6	100	Plants with the modal number of tillers were taken at random from an early planted area. Only tillers with the modal height were taken into consideration.
Co. 1	21·6	12·9	7·5	3·6	1·5	32·3	20·4	100	
Co. 2	21·6	15·2	9·5	4·2	2·1	29·2	18·2	100	
Co. 5	22·7	15·7	9·9	4·8	2·9	27·0	17·0	100	
Co. 7	21·2	15·3	9·6	4·7	1·8	29·0	17·9	100	

In six of the varieties, GEB. 24 and Co. 1 representing early, Co. 2, Co. 3, and Co. 7 medium, and Co. 4 late, after the count of tillers every week, six plants with the modal value for tillering were picked out from the adjoining portions in the field and were dissected carefully to denote the chronology of tillering and to measure the lengths of the different parts. By removing leaf after leaf from the bottom of every tiller the internodes between are exposed and finally a stage is reached when there will be seen the rudimentary or developing ear on the shoot, unless the plant is still in the active tillering phase.

The process of dissection and recording of measurements for even six plants every week formed a laborious process. Even in a pure line no two plants are absolutely alike and since growth measurements cannot be carried out on the same plants every week, the only feasible way of recording growth measurements was to select every week, plants with the modal value of tillering for that week and record their measurements. Then there is the question of fixing the unit of observation whether it should be the whole plant or only a tiller. It was found that there was considerable range of variation between the tillers of the same plant or tillers of the same chronology on different plants taken as samples for dissection. Since observations made on number of leaves per tiller, number of elongated internodes per tiller, height of shoot, sequence of tillering and its bearing on the date of emergence of the ear, length of emergence of the ear, length of peduncle and length of flag leaf, size and number of spikelets per ear, weight of grains etc., did not show significant variation in any of these characters with reference to the chronology of the tiller, the recording of measurements at successive intervals was confined to tillers that showed the modal shoot height.

Shoot growth. A rice plant during the process of tillering, and until the formation of the primordial ear does not show any elongated

internodes. The only exceptions to this finding are the deep water paddies which throw out elongated internodes even in early stages s multaneously with tillering. Vigorous shoot growth starts only with the commencement of ear formation.

The elongation of the different parts of the shoot follows a regular sequence. If a plant has five internodes, the basal one starts its growth first, quickly followed by the one next above it. The next two commence their growth a week after and almost complete it by the time the top-most one and peduncle begin to grow.

Table No. VIII.

Growth of Shoot.

(N. B.—The numbering of internodes is from top to bottom).

Variety.	Date of observation.	Interval in days.	Growth in length in m. m.								
			Internodes.						Peduncle.	Ear.	Total height of shoot.
			I	II	III	IV	V	VI			
GEB. 24	21/10	...	...	...	23	21	...	...	...	2	46
	28/10	7	...	5	50	26	1	...	...	11	93
	31/10	3	5	50	58	17	1	...	1	94	226
	3/11	3	13	102	61	14	...	...	4	230	424
	7/11	4	14	121	67	31	...	...	5	243	481
	*11/11	4	136	137	66	20	...	...	120	237	715
	14/11	3	246	149	77	22	1	...	361	248	1104
Co. 1	13/11	...	...	1	27	2	...	...	...	4	34
	20/11	7	3	30	32	9	...	...	...	60	134
	*27/11	7	47	66	38	14	2	...	16	232	415
	4/12	7	214	66	36	8	...	...	369	240	933
Co. 7	13/11	...	...	...	2	24	...	...	...	knob	26
	20/11	7	...	1	14	26	3	...	...	2	46
	27/11	7	5	43	45	37	4	...	...	80	214
	4/12	7	51	104	59	29	...	...	15	242	500
	*11/12	7	247	129	42	23	...	...	300	241	982
	8/12	7	273	127	54	29	...	...	344	243	1070
Co. 2	26/10	...	...	...	2	6	1	...	...	knob	9
	2/11	7	...	1	15	32	...	...	...	1	49
	9/11	7	2	12	74	59	7	...	...	27	181
	16/11	7	12	87	97	54	16	...	5	228	409
	*23/11		131	155	95	44	3	...	75	248	751
	30/11	7	275	151	94	48	6	...	344	244	1162
Co. 3	3/11	...	...	2	9	59	36	...	...	1	107
	10/11	7	1	8	64	70	26	2	...	15	186
	17/11	7	8	52	99	69	24	...	1	139	392
	*24/11	7	28	107	102	68	32	...	10	2·4	601
	1/12	7	244	162	108	70	24	...	313	259	1180
Co. 4	25/11	...	...	1	7	47	44	5	...	0·5	105
	2/12	7	...	...	...	...	..	...	...	1·7	..
	9/12	7	2	22	82	61	21	2	...	26	216
	16/12	7	10	76	151	69	32	3	1	154	496
	*23/12	7	30	131	163	68	45	3	11	223	674
	30/12	7	281	199	142	64	26	...	360	230	1302

* Indicates the date of emergence of the ear.

Table VIII shows the comparative growth of the shoot in the different varieties. From the figures in the table it is clear that the ear completes its growth in length a week to 10 days before the date

of emergence of the ear. During this period, the top-most internode and peduncle proceed with their elongation while the internodes below stop almost all growth. The process of elongation of the shoot in general continues four to five days after the emergence of the tip of the ear from the leaf sheath. Late ears take a day less to complete the process.

Incidentally notes were taken regarding the average number of leaves in a tiller, number of elongated internodes per tiller, height of the shoot, sequence of tillering and its bearing on the date of emergence of the ear, length of emergence etc., and they are recorded below:—

Number of leaves per tiller. The number of leaves above the prophyll or tillering zone of the main and side tillers that have formed daughter tillers is a fairly fixed character for a variety under normal conditions. The number is more in the late than in the early varieties. In the varieties studied the range is from five to eight leaves per tiller. (Table IX).

Table No. IX.

Number of leaves per Tiller.

(Above the prophyll or tillering zone).

Variety.	Duration in days.	Average number of leaves per tiller.
GEB. 24	149	5·1
Co. 2	157	5·9
Co 3	161	6·4
Co. 5	164	6·8
Co. 6	176	7·7
Co. 4	192	7·9

The flag leaf and the leaf previous to it commence their development almost along with the ear. Each tiller will have three to six functioning leaves at a time, and the number goes down to three by the time the crop completes the flowering. When it is ready for harvest all except the flag leaf dry away.

Number of elongated internodes in a tiller and height of tiller. As the number of leaves produced in a tiller is a variable character, the number of internodes also has a similar variability. Actually a tiller may have only four to six elongated internodes, the late varieties having a larger number. Early planting and rich soil tend to increase the usual number of elongated internodes and this is generally a predisposing cause for the crop to lodge even before it is quite ripe. The height of a tiller made up by the internodes, peduncle and ear highly reacts to variations in environments. To note the individual variations of the different tillers in a plant with regard to height, ear emergence, length of emergence etc., ten plants with the modal, five with the

maximum and five with the minimum class of tillers were marked in the ten varieties under study and the observations recorded.

Poor tillers are invariably short. Plants with the modal and maximum number of tillers do not show much variation in average height. The height of an individual tiller in a plant seems to entirely depend upon its vigour and environment rather than on its chronology. It is not always the primary shoot that is the tallest. Later formed tillers are at times even taller than the first formed ones but those that are formed very late remain short. In spite of initial differences, late formed tillers speed up and attain the same height as the first ones by the time the plant starts flowering. Sometimes in a tiller which has a fewer number of internodes than the normal, the height is made up by the extra elongation of the peduncle. Generally the heights of different tillers on a plant of normal growth are almost the same, the differences being within ten percent of the mean. It has always been a useful criterion in selecting single plants for economic value which have a fair number of ear bearing tillers all of the same height.

Sequence of tillering and ear emergence. Omitting Co. 1 and Co. 7 which had been planted late, the observations recorded below hold good for all the varieties under study. A plant takes five to seven days to complete the emergence of all its ears whether it is a good, average or poor tillerer. If the plant happens to be particularly poor, it may take a slightly longer time. Though very often the first formed tillers throw out their ears first, it is not always the rule. The forwardness at emergence, as in the case of height, seems to depend upon the vigour and environmental conditions of individual tillers. The modal date of emergence of the ear is slightly earlier in a well tillered plant than in one with fewer tillers. Tillers that are formed late in the season are invariably late in earing and they are also definitely shorter in height.

Spikelets – number, setting and size. The length as well as the number of grains per ear, are almost the same in early formed tillers, but the number of spikelets per unit length generally decreases gradually with the lateness in tiller formation though the vigour of the individual tiller might have much to do with it. The percentage of setting in a variety seems to be a fairly definite character. Within the variety, however, the percentage of setting is low in 'late formed' tillers. As regards the weight of grain, those on the early tillers are usually heavier than those in the late tillers. Very late and poor tillers, as in the case of ratoons, definitely have smaller grains.

Summary. Tillering is an important developmental phase in cereals. It is best studied by counting the tillers produced by each plant in a sample of a population. For a transplanted crop with a pure line, and in well uniformly prepared fields, a sample of fifty plants may be found enough to carry on this study. Active tillering phase

commences about two weeks after planting and will be in full swing for three to five weeks depending upon the duration of the variety. When the tillering phase has reached its maximum, reduction in tiller number starts by the death of the late and ill developed tillers. The 'critical period' of tillering i. e., the stage at which enough tillers are formed to result in ears, is reached two to three weeks before the maximum tillering phase is attained. The trend of distribution of tillers in plants of different tiller classes follows a systematic course and it does not seem to vary much among the varieties under study. Under normal field conditions the percentage of functional tillers to the total tillers in a plant is almost the same irrespective of the number it produces, but this percentage is evidently a varietal character, being low in later varieties. The yield per ear and weight of grain in the different tiller classes are almost the same. Hence it follows that keeping the environment the same, any increase in the average number of tillers per plant or per unit area correspondingly goes to increase the yield of grain per plant or per unit area. As early conditions have a marked predetermining influence on after development, to obtain good yields the plant must be provided with optimum conditions for vigorous growth by the production of a large number of tillers earlier to the 'critical period.'

Ear development. The interval between the completion of tillering and commencement of ear formation seems to depend on the duration of the variety. The interval increases with the increase in duration. In the case of early varieties and in late planted crops ear formation commences even before tillering is completed. The relationship between tillering and ear formation is a useful criterion to be made use in adjusting the time of application of a fertiliser to the crop. The formation of the ear primordia commences about 24 to 31 days before the date of emergence of ear tip, the interval apparently depending on the duration of the variety. The ear completes its growth in length about a week before its date of emergence. The linear development of all the spikelets and the mechanical strengthening of the rachis, rachilla and glumes are complete by the time of its emergence.

Shoot growth. Nearly 90 per cent of the height in a mature rice shoot is attained during the month preceding flowering. Active growth of shoot starts almost with the commencement of the ear development. Elongation of the different parts of the shoot proceeds from base upwards in regular succession. A week or ten days before the emergence of the ear, the top-most internode and peduncle starts growth while those lower below would have reached their full length. Growth of all parts of the shoot stops with the commencement of general flowering, which is four to five days after the emergence of the ear tip from the shoot.

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MARKETING OF CULTIVATORS' COTTON AT TIRUPUR, MADRAS PRESIDENCY

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(*Note*:—Investigations into the finance and marketing of cultivators' cotton in Tirupur town and in two representative villages of the tract were carried out by the author with the aid of a scholarship from the Indian Central Cotton Committee in 1932 and 1933 and two reports were submitted, the first for the town and the second for the villages. The article below is an abridgement of the first. The other, on growing, finance and marketing of cotton in the villages of the tract has been published in "Agriculture and Livestock in India" of January 1935.)

The town of Tirupur situated in the middle of Coimbatore district has grown in importance in recent years due to its cotton trade and is now one of the largest centres of cotton trade in South India. The total quantity of cotton dealt with per annum is about 80 to 100 thousand bales. Cotton grown in the surrounding area, to a radius of about 50 miles, is almost all marketed through Tirupur. Cambodia and *Karunganni* are the chief varieties disposed of, *Uppam* and *Nadan* being received in small lots. The proportion of these arriving at Tirupur may be estimated as follows:—Cambodia, 60%; *Karunganni*, 30% *Uppam* and *Nadan*, 10%. The investigation was carried out from April to July of 1932, as the marketing season at Tirupur is normally from March to August. A total of 590 sellers were examined in 90 days.

The Market Organisation. The whole of the Municipal town of Tirupur serves as a market place. Spot purchases are generally the rule though sales are also effected on the forward contract system by the town merchants. Situated in the central part of the town are about 30 commission *Mundies* or depots, the owners of which act as financiers and commission agents for the sellers of *kapas*. There is storage accomodation available in these *Mundies* and advances are

made against the security of *kapas* stored. There are over 20 ginning factories within the town and connected with these are the town dealers who purchase *kapas*, gin it and sell as lint for ready price or supply to the agents of mills with whom they could enter into a contract. Sellers of *kapas* (village merchant or the cultivator) therefore effect sales either in the commission *Mundies* or in the yards of the ginning factories.

There are no market committees, no rules and by-laws and no system of control over the conduct of sales, deductions and allowances. Records of purchase and sales are maintained by the merchants or the *Mundies* concerned. During the years 1918-1920 an attempt was made to start the Holmes Cotton Market under the auspices of the Tirupur Municipality and controlled by the then Coimbatore Cotton Marketing Association, with a view to regulate the purchase and sale of cotton. The marketing yard and some buildings were constructed at a cost of about Rs. 50,000. The dealers and merchants of Tirupur, however, were against the starting of the market as it was likely to affect their interests. By-laws were however prepared and submitted to Government for approval in March 1920. Just then the Madras District Municipalities Act of 1884 was replaced by that of 1920 according to which the Municipal Councils ceased to have adequate powers to start and run cotton markets. As a result no market was organised, the merchants had their own way and the buildings and yard were not used for the purpose for which they were intended.

The Commercial Crops Markets Act of 1933. After much enquiry and consultation this Act was introduced and passed in 1933, as an enabling measure, whereby the Government could declare any area as a regulated market for any specified commercial crop. Cotton, groundnut and tobacco have been declared to be commercial crops for the present, in connection with this Act. The first market under this Act is to be organised at Tirupur for cotton from this year. As per regulations under the Act the Market Committee of 12 members has just been formed. This consists of five members elected from among the growers, four from the merchants, one from the Municipality and two nominated by the Government. The Committee will frame suitable by-laws to run the market within the Municipal limits of Tirupur which has now been declared to be the market area. The editorial note in the November 1935 issue of this Journal discusses fully the scope of this Act and the formation of the first market for cotton at Tirupur.

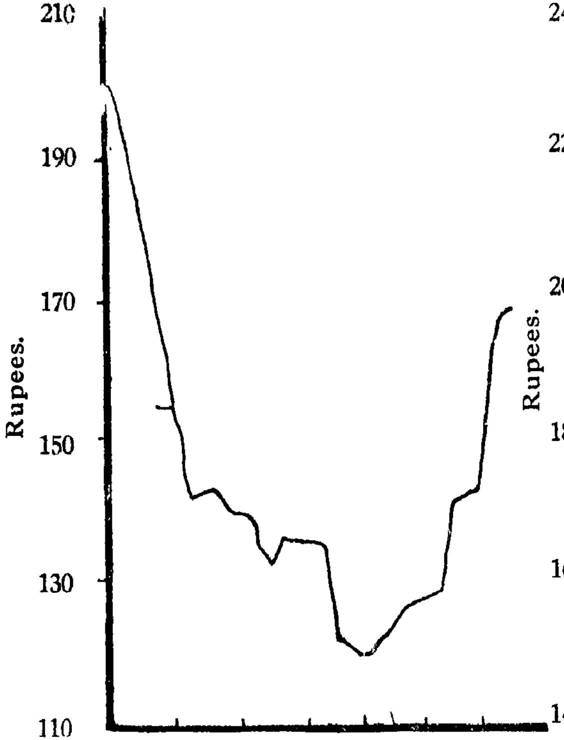
The System of Purchase and Sale. There are two systems, viz., buying of ready *Kapas* or lint and the forward contract system. But the latter is in vogue only during the busy part of the season and mainly encouraged by Messrs. A. & F. Harvey and Binny & Co. Though these firms purchase as lint they make it a condition to inspect the

kapas before ginning and satisfy themselves as to quality. They have got their own standards of quality, fixed up according to their requirements, and the rates paid are dependent upon these. The merchants entering into such forward contracts for supply of cotton within a specified period, usually a month, purchase *kapas* in the villages through their agents and also within the town limits, in the commission *Mundies* or factory yards where ready *kapas* is always available. Agents of consumers up country purchase lint through-out the season according to their requirements from the factories or lint *Mundies.*

The seller, bringing in *kapas* for sale at Tirupur, can sell it by himself in any of the factory yards or even on the road-side, or take it to a commission *Mundy* and get the *Mundy* man's help in the disposal. *Kapas* arriving at the *Mundy* is unloaded, marked and stored. Buyers come round, inspect the *kapas* of each bag and make their own offers. The *Mundy*-man argues and tries to settle as best a price as possible. When settled, the weigh-man weigh them and the buyer arranges to cart the *kapas* to the godown he has fixed. The cartage is however, paid by the *Mundy*-man out of the commission he collects from the seller. Disputes are rare as the buyer takes care to examine well the contents of each *borah* or bag before settling the price. The price of stained or inferior quality *kapas*, kept in separate bags, is separately settled. If there is any dampness, settlement is made beforehand for any allowances to be made in weight. The *Mundy*-man pays the seller immediately the total cost of *kapas* sold less the commission at Rupee one per *pothi* of 260 lb. But the buyer pays the *Mundy* only in the evening. If the prices are unfavourable, the stuff will be stored for future sale and an advance paid to the seller not exceeding 75% of the value of the *kapas* stocked. The seller can then return to the village for purchasing another consignment of *kapas* or if he is a cultivator use the money for cultivation and other expenses.

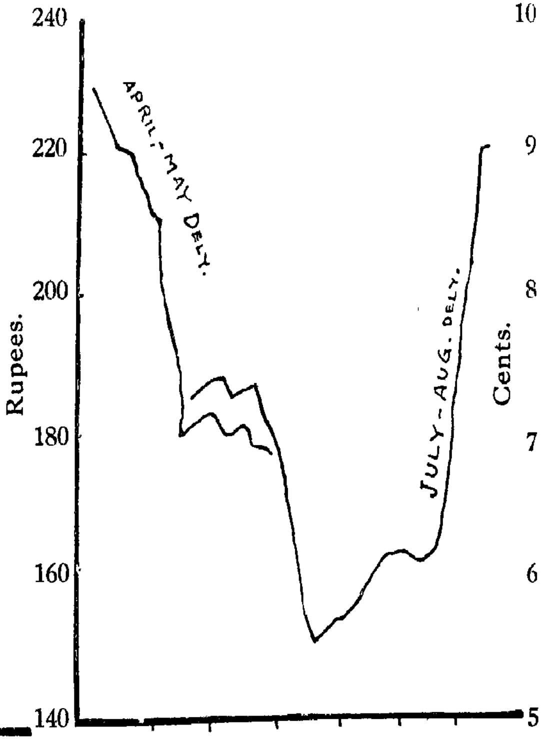
The seller, taking his *kapas* to any of the ginning factory yards can easily secure the help of any of the petty brokers available at such places. At this place he has to effect the sale the same day as no storage accommodation is given in the factories. The commission due to *mundies* is saved, the broker is paid only two annas per *pothi* and often satisfactory prices are obtained. Some effect the sale without the aid of the petty broker. Here also the buyers inspect the *kapas* in each bag and settle the price. Then the weighment is made in the factory yard where the buyer proposes to gin and the cost of *kapas* paid. During the season under investigation about 50% of the total arrivals of *kapas* was sold in this manner without the aid of commission *mundies.*

Employment of Brokers. The employment of a broker is purely voluntary. Generally the buyers do not employ brokers. Most of the



1

Price of Lint of best Quality Cambodia
Per Candy of 520 lb. 1932.



2

Price of Broach Cotton in Bombay
Per Candy of 784 lb 1932.

3

Price of Cotton in New York in
Cents Per lb. 1932.

sellers, however, find it more convenient to have the aid of the broker. Such of those who are available near the factories, have no capital, but many of them are smart and experienced. The commission *mundy*-man is an agent, broker, banker and a friend all rolled into one, and the sellers who are 'customers' to his *mundy* seem to have full confidence in him. The commission *mundies* provide storage space without charge and would have invested several thousands of rupees, each of them, in godowns and as advances to sellers.

Rates. No rates are posted or announced, but the prices are directly affected by those of Bombay first and then of New York. The curves included at the end of the article show how Tirupur prices fluctuate in unison with those of Bombay and New York. There is no organisation among buyers to fix rates or for fixing grades of *kapas* or lint. It is left to the individual buyer and seller to settle a satisfactory price among themselves. Good deal of bargaining takes place, and when there are a large number of buyers in the market the prices tend to go up. Following the rise in Bombay or New York prices, the merchants freely push up Tirupur prices. Again at about the end of the stipulated forward contract period there may be a rush of buyers and at that time the prices have a favourable turn. Information about ruling prices in the Bombay market is obtained privately through telegraph and radio and also through "The Daily Bombay Telegraphic Cotton News" published daily. The *mundies* in their turn inform their customers (the sellers in the villages) by post daily the day-to-day variation in prices at Tirupur so that arrivals at Tirupur can be regulated.

Weighment. Beam scales, hung from a tripod of bamboos or iron rods, are used for weighment both in the factories and in *mundies.* The weights are W. & T. Avery's iron weights and a set used for each scale is as follow: — 56 lb. (six of them); 28 lb.; 14 lb.; 7 lb ; 4 lb.; 2 lb.; and 1 lb. One of the weighmen, well experienced in the work, holds one of the chains of the weight pan with his left hand and now and then gently pulls to feel how much more weight he should add. When the pans are just about to counterpoise, he calls out the total. The payment is made at the rate per *pothi*, maunds and pounds as per equivalents in lb. noted: —*Candy*—784 lb.; *Pothi* —280 lb.; Maund—28 lb. At the time of investigation a *candy* varied from 500 to 520 lb. and a *pothi* was equivalent to 260 lb. Recently the Government fixed the weight of a *candy* at 784 lb. as that of Bombay and the *pothi*—at 280 lb. The weighmen in the *Mundies* are paid by the Mundy-man out of the commission and in the factories by the dealers or merchants purchasing kapas. In the former the rate paid is per *pothi* of kapas and in the latter it is per *candy* of lint ginned.

Disputes, Deductions and Allowances. No disputes were noted either in the Mundies or in the factories. Evidently the sellers and

the buyers are satisfied with the prevalent methods of transaction, deductions and allowances. The following deductions and allowances are made:—

A. For *kapas.*

1) 1 lb. whenever the pointer in the beam scale stops exactly in the middle, the weights exactly counter-balancing the bags.

2) 11 lb. per 1000 lb. in weight deducted for wastage, impurities, dust, stains, etc. This is really 1% plus one lb. for every 1000 lb.

3) In the factory yards 1 lb. less is noted when the weights are noted after each weighing. In one place the weights were noted 2 lb. less. This practice is not found in *Mundies* and is to be deprecated.

B. For Lint.

1) 1 lb. per candy is deducted for sample purposes.

Customary Charges. 1. Commission. In the commission *Mundies* Re. 1 to Rs. 1—2—0 per *pothi* of kapas and Rs. 2 per candy of lint sold, are charged as commission. These include charges for loading, unloading, weighing, carting and the amount for charity. 2. Charity. One anna per *pothi* of *kapas* and two annas per candy of lint, are charged to the seller under charity. No separate accounts are maintained for amounts received by way of charity and no charitable institutions are maintained for the benefit of the sellers. 3. Brokerage. A brokerage of two annas is paid to the broker per *pothi* of *kapas* sold with the aid of a broker. For lint it is four annas. 4. Insurance. *Kapas* stored in Mundies is not insured, but for lint stored the insurance charge is four annas per *candy*, for a period not exceeding six months.

Storage and Advances against Deposit: It is only in the commission *Mundies* there is storage accommodation available for *kapas* brought into Tirupur for future sale. The godowns in factories are utilised for stocking *kapas* of merchants ready for ginning as well as lint and seeds for sale. The Co-operative Trading Society provides storage godowns for its members, a large number of whom are merchants themselves. The Society and the *Mundies* advance money against deposit of *kapas*. The interest charged in *Mundies* is said to be from 12 to 15% but actually no interest is charged for periods less than a month.

Statistics of Arrivals and Sales. There is no common record for arrivals and sales at Tirupur. It is not possible to judge with any accuracy the total arrivals of *kapas* on any particular day as the carts arrive at all times of the day. Lint also arrives for sale at Tirupur from several places up-country where there are ginning factories. An idea of the sales effected on each day can be had if one takes pains to

make enquiries of all the dealers, merchants and factories and then make an estimate of the total.

The Sales Society. The Tirupur Co-operative Trading Society has been working for some years with great success, but a good many of the members belong to the merchant class of the town. The society advances on produce pledged upto 70% of the value. There is a branch working at Udamalpet. The Society is running a large seed farm for the improved strain of Cambodia cotton, financed by the District Bank of Coimbatore. The Indian Central Cotton Committee subsidises this seed multiplication scheme by which it is hoped in the course of a few years, to maintain an assured supply of the improved type of Cambodia cotton seed to all the growers in the Tirupur tract. The society, like the *Mundies*, charges commission on sales of *kapas* and lint, besides godown rent and insurance fee for storage. An interest of about 9% is charged on advances made on the security of produce.

Transport and Communications. Seven metalled roads converge at Tirupur from different directions and no seller has experienced any difficulty owing to bad communications for any long distance, even though many of them wend their way from villages and towns 30 to 50 miles distant from Tirupur. The majority of the villages in the tract appear to have at least one metalled road running not far from their vicinity. The country double bullock cart is practically the only vehicle for transport of *kapas* or lint, though in the town of Tirupur carts drawn by coolies is more common for transport within the town limits. Lint purchased by the Coimbatore mills is transported by the double bullock cart rather than by train as the former is the cheaper mode.

Concluding Statement on Market Investigations. It is worthy of note that only 8 % of the sellers examined were actual growers who brought their own kapas for disposal at Tirupur. Out of 125 sellers examined during July, 30 were what may be termed 'cultivator traders', persons having some area of garden, either of their own or in their family, but turned into traders for the season, or for the past few years.

1. Number of days the market was visited, 96.
2. Number of sellers examined, 590. (In Mundies, 127; in Factories, 463)
   Growers, 50; Traders, 540.
   During July :-Growers, 13; Cultivator traders, 30; Professional traders, 82.
3. Number of sellers who did not sell on the same day, 46.
4. Number who did not submit to the customary market deductions, None.
5. Number who did not pay brokerage, 58.
6. Number who had taken advances, 72. (60 from Mundies and 12 from factory owners or merchants).

AN ACCOUNT OF THE STUDENTS' TOUR

BY J. RAGHOTHAMA REDDY, II B. Sc. Ag. Class.

From Coimbatore to Anakapalli, from Central districts to the northern-most portions of the Circars is no mean distance and yet we arrived after 42 hours at the destination in a state of enthusiasm that would reflect credit to any party on tour.

On the bright morning of 6th January we all set ourselves well to our task, but alas, our enthusiam and rosy dreams of future were not to continue long and we received the rudest shock by the sudden passing away of one who toiled, enjoyed and suffered with us for well nigh over a year and a half, a loss to all and an irreparable one to many.

Then followed two dreary days of monotony, of reflection, and of dead and dying enthusiasm. Early next day the last rites over, the party settled down to reconcile itself to the tragic incident and succeeded but partly.

The Sugarcanes at Anakapalli were of great interest and while we followed the Superintendent round the experimental area we admired his force of conviction as he explained the way he brought down the cost of production to Rs. 2—8—0 per ton of sugarcane.

Next morning we were invited to Kasimkota where Mr. D. Appa Rao an 'old boy' of the college is working hard at his extensive orchards. Oranges of all types—sour and sweet—Batavian and pomeloes of all descriptions were well represented in this garden of his. The proprietor explained at length the various stages of orchard growing in a manner that easily showed him to be a scientific horticulturist. He very kindly treated us to tea and bade us farewell appealing to us at the same time to go back to our lands. Our thanks are in no small measure due to him.

Our next halt was Samalkot where we stayed at the farm and soon acquainted ourselves with the peculiarities of deltaic agriculture. Later in the day we visited the Sugar Factory as also the distillery attached to it and saw with wonder the dirty-looking semi-solid palmyrah jaggery change into shining crystals of sugar and strong-smelling alcohol. Our later visits in company of Mr. Raghava Rao Asst. Director of Godavary Districts to Peddapuram silk factory and to the extensive canefields of the Jaggery Factory and the orchards of the proprietor were no less instructive than the rest.

Moving forward we reached Rajamundry on 11th and went out straight to Dhowleshwaram to see that magnificent achievement of Science—the grand anicut—across *Sapta* Godavary. Thanks to the kindness of Mr. Raghava Rao we pleasantly 'cruised' on board a steam launch and moved on to the *lankas*, for an hour and returned.

Late in the evening we reached Royal Nurseries at Kadiam and no sooner had we arrived than we were treated to a sumptuous tea, whereafter the proprietor took us round and explained the business side of his concern. We thus left for our lodgings with the happiest recollections of a day well spent. Early next morning we visited the famous citrus gardens associated with the name of the great social reformer and literateur, the late Veerasalingam Pantulu.

Leaving Rajahmundry at noon we reached Maruteru nearly at dusk after a rail and road journey.

Maruteru took us a full day to study and we all heartily enjoyed the hospitality of the Staff and left the place, to put it in the language of the Superintendent, "much wiser than we came".

Masulipatam was our next camp where besides the usual enquiries we played and lost a hockey match against the Noble College.

The last camp of the tour was at Bezwada where thanks to the generosity of the great philanthropist K. Nageshwara Rao Pantulu we got, palatial lodgings at his private home.

The next visit of interest was to the citrus gardens at Pedda-vadlakudi where soil and climate have contributed to the eminence of the industry with the total absence of any advanced horticultural practices.

Guntur with its chillies and tobacco came next and kept us busy for a whole day. The Government farm with its enthusiastic staff was more interesting to us than any other place. The party they gave us was certainly the best.

The tour came to a close with a brief but an interesting visit to Veeyyur Sugar Factory. We were very kindly received by the Manager and were shown round by the heads of the respective departments. We left greatly impressed by the magnitude of the factory and the sound co-operative basis of the great concern and wished all success and prosperity to the premier Indian Sugar Concern of the South.

Our thanks are due to all gentlemen within and without the agricultural department who were responsible for making the tour both instructive and enjoyable.

To Mr. Raghava Rao, A. D. A. of Godavary Districts to Mr. Venkataraman, Supdt. of Maruteru Research Station and Mr. Vittal Rao, Manager of Guntur Station we owe a special debt of gratitude.

To Mr. Raghavachari, the leader of the tour to whose ability and kindness not a little of the success of the tour was due, we offer our heartiest thanks. Lastly to Messrs. B. Suryanarayana and V. Surya-narayana we are thankful for what all they have done for us.

THE PASSING AWAY OF KING GEORGE

In order to express deep regret at the passing away of His Majesty King George V, a meeting of all the residents of the estate was held at the Freeman Hall at 4-15 P. M. on Friday 24th January 1936 under the joint auspices of the Madras Agricultural Students' Union, the Indian Officers' Association, the Association of Economic Biologists, the Officers' Club, the Ladies' Club, the Students' Club, the Fieldman's Association and the Association of Upper Subordinates.

Mr. R. C. Broadfoot who presided over the joint meeting spoke as follows: —

Mrs. Munro, Gentlemen,

This meeting has been called under the auspices of the various clubs and organisations at the Agricultural College to publicly express our sorrow at the death of His Majesty King George V. Similar meetings have been held all over the world and all have proclaimed the love and high regard in which His Majesty was held by every one. As a King by precept and example he was kingly, sympathetic to all his subjects and a shining example of what the head of the Empire should be. His Silver Jubilee celebration held last year must have been to him a very great joy and his speech on that occasion when he dedicated the remaining years of his life to the service and welfare of his subjects was an expression of sincerity which will not be forgotten. None realised at that time that his death was so near but we have the satisfaction of knowing that his work up till the time of his death was for the peace and welfare of all Nations. His death was peaceful as befitted a gentleman who had lived a full good life, and today we mourn his passing with very sincere regret. The British Empire has been blessed with many wise and good rulers but King George V, will live in history because of his broad sympathetic outlook and good works. With these words I now move the following motion of condolence and request that those present will stand and receive.

This meeting places on record its sense of deep sorrow at the demise of His Majesty King George V and respectfully offers its heartfelt sympathy and condolence to the members of the Royal family.

The following resolution was also then moved from the chair and passed.

This meeting begs to record its sense of loyalty and devotion to the new King Emperor, His Majesty King Edward VIII.

THE SIXTH INTERNATIONAL BOTANICAL CONGRESS.

Sir E. John Russell, Director of the Rothamsted Experimental Station at Harpenden, England, speaking before the Sixth International Botanical Congress, called attention to the fact that plants, constantly sucking upward the water that trickles and oozes downward through the ground, profoundly affect the character of the soil in which they grow. In the eastern part of England the water drainage through cultivated soils is only about half that through uncultivated soils. The whole nature of the soil is affected, and the marked differences between feebly and strongly leached-out soils turn very largely on the intensity of action of plant roots in removing the soil water Associated with this removal of water is also a transfer of mineral substances and nitrates from the subsoil to the aerial parts of the plant. Calcium, potassium and silica in particular are lifted in quantity to the leaves and stems; when the plants die they fall back on the surface

of the soil. The details vary with individual plants, and in the end striking differences may result. The general result is, however, that this process counteracts the washing down by the rainfall, and it confers upon the soils of mild humid countries one of their characteristic properties that the upper layer tends to be richer in calcium and potassium and to be more nearly neutral than the lower layers. These characters are of profound ecological significance and react greatly upon the vegetation. The plant roots evolve considerable amounts of carbonic acid. This evolution of carbon dioxide is of special importance in dry regions where soils tend to be alkaline, for it offers the possibility of reducing the alkalinity and so profoundly changing the vegetation. Experiments are being tried in various regions to find crops which by evolving large amounts of carbon dioxide from their roots, can be used for the reclamation of alkali soils. Plants also exercise marked influence on each other through their roots. The legumes or plants of the pea-bean-clover family, not only obtain nitrogen for their own needs through the activities of the bacteria that live in their root nodules, but also excrete it and make it available for other plants. On the other hand, several British investigators have conducted experiments, in which drainage through the perforated bottoms of trays in which plants were growing was permitted to flow over the roots of other plants. The latter were unfavourably affected, either through poisons formed by the roots in the trays, or through their absorption of all available nitrates, or through some combination action resulting finally in a nitrogen poverty. The imporance of roots in other connections was also pointed out: weed competition, crop rotations, and the final conversion of dead roots into soil humus.

The possibility was suggested of fighting the fungus diseases that now devastate crops by sowing or spraying the germs of counter-diseases. The suggestions came from research laboratories in widely separated parts of the world. Dr. S.D. Garrett. of the University of London, who carried on his studies in Australia on a destructive wheat disease called "take-all," found in certain types of soils a complex of fungi and other obscure organisms useful in combating the disease. From the University Farm, St.Paul Minn., Miss Delia E. Johnson reported the antagonism of a newly discovered species of bacterium against the smut diseases of corn and various small grains. A most comprehensive study in the field of microbiological antagonisms was presented by Professor S.Endo, of the University of Tokyo. He has examined dozens of kinds of bacteria and moulds for their effects on several different disease-causing micro-organisms. Some he has found to be decidedly depressing, others lesss so; a fair number completely lethal. It may be that bacteriologists and plant pathologists are ready to take a leaf out of the book of the entomologists, who long ago learned to fight enemy insects by turning their own insect enemies loose upon them.

Evolution appears to be at its most active state in producing new varieties of plant diseases affecting grain crops. What one species of smut fungus can do in the way of producing new strains was outlined by Professor E. C. Stakman, of the University of Minnesota. He described a research project in which a single reproductive cell of this smut fungus was isolated and its offspring propagated in the laboratory. Within a few months there were 162 distinct physiological strains of this one fungus from the single-celled start. These physiological strains of plant disease fungi are the more difficult to deal with because within a given species they all look alike. They are different only in their behaviour. Thus there is one well-known variety of stem-rust of grain that attacks wheat and barley but not rye and oats, another that attacks rye and barley but not wheat and oats, and still another that attacks oats but none of the other small grains. Under the microscope they all look exactly the same. The multiplication of fungus varieties that occurred with the smut specimen in the laboratory is duplicated

thousands of times over in the field. Many new varieties rise by hybridization through sexual crossing of existing varieties, but others occur without inter-breeding, through the "straight evolution" process of mutation or 'sporting". There is an endless race between the plant breeder and the natural new origin of these plant diseases. The breeder will carefully produce a new crop variety that is resistant to all known diseases—only to have a newly-originated disease attack it.

Young plants, cut down and buried in the soil as fertilizer, decay much more quickly than older plants of the same kinds do. This was one of the points discussed by Dr. Selman, A. Waksman of the New Jersey Agricultural Experiment Station. In these experiments a number of plants were cut at different stages of growth and definite amounts allowed to undergo decomposition by micro-organisms, under identical conditions. Of the young plants, 73 per cent. of their material was decomposed in thirty days, while it took sixty days to decompose only 42 per cent. of the material of older plants. One of the reasons for the difference in decomposition rate is the marked difference in the chemical make-up of older and younger plants. The older plants contain higher proportions of more resistant materials, especially the celluloses and lignins. The latter substances, which are the basis of the "woodiness" of wood, are exceedingly difficult for bacteria, fungi and other micro-organisms to digest. Moreover, there is a difference between the lignins of old and young plants; in the younger state the lignins are chemically "tenderer" and easier to break down. Differences in humus formation in the soil are traceable not only to differences in the plant materials that are decomposed but also in the living agents of decay, the bacteria, molds, protozoa and other microscopic forms. Insects, worms and other larger animals that feed on dead wood and leaves also aid by chewing them into more manageable morsels for the smaller creatures. The relative abundance of these micro-organisms is influenced partly by the nature of the dead plant materials themselves, for some of them like wood, others straw, still others dead leaves; and also by such factors as temperature, moisture, soil ventilation and soil acidity or alkalinity.

X-raying plants to produce hereditary changes in their offspring is not limited in its effects to what happens in the immediate outcome. An x-rayed plant may produce offspring with new peculiarities, such as changed leaf-size or flower-colour, which will duly appear in subsequent generations. But these generations may also begin to produce other changes, even without being x-rayed themselves. Changes of this character, and an explanation for them, were described by Professor T. H. Goodspeed, of the University of California, one of the pioneers in the field of x-ray genetics. While the details of the process are highly technical, the essential fact underlying the three types of cellular change is a state of instability, of continuing change, induced in the chromosomes by the first impact of the x-ray bombardment. (*Extract from Science—Supplement—* Vol. 82, No. 2123, pp. 10–13).

ABSTRACTS

Effects of Ethylene on Plant Growth Hormone. *Science.* Vol 82, No. 2156, p. 151. Heteroauxin, or plant growth hormone (B-indolyl-acetic acid) is known to have several effects on plants, including promotion of stem elongation, inhibition of bud growth, stimulation of root formation, production of stem swellings and stimulation of epinastic movements of the leaves. With the exception of the first two, ethylene gas also has these effects.

According to A. E. Hitchcock, ethylene, heteroauxin and other substances all act in essentially the same way. This conclusion is based, apparently, on the similarity of the effects of ethylene to those of heteroauxin. There are many cases, however, where these two substances do not have the same effect.

For instance, heteroauxin increases the growth rate of *Avena coleoptiles*, and the amount of increase is dependent on the amount of heteroauxin supplied. If ethylene has the same effect, it should increase the growth rate, and the degree of increase should depend on the concentration of the ethylene. However, four groups of Avena seedlings were placed for twentyfour hours in, respectively, air 0·001 per cent, ethylene, 0·2 per cent, ethylene and 2 per cent. ethylene. The rate of growth in all three of the groups treated with ethylene was approximately the same, and was about 30 per cent. less than the rate of growth of the controls. It thus appears that, in this case, ethylene could not have acted in the same manner as a growth hormone.

It is well known also that heteroauxin increases the number of roots formed by pea cuttings. These cuttings can take up enough hormone to give maximum root formation when placed inversely in a solution of hormone for twelve hours. However, when they were placed for twenty-four hours in an atmosphere containing ethylene (whether treated with hormone or not), root formation was not affected.

Cuttings of *Salix* were also used for tests on the effect of ethylene. The experiments described here were performed in May. The cuttings were of second-year wood and about eighteen centimeters long. Four groups of cuttings were treated in different ways, as follows : (1) control, (2) 0·1 per cent. ethylene for two weeks, (3) heteroauxin applied to the top of the cuttings in the form of lanoline paste, treated both with heteroauxin and 0·1 per cent. ethylene. The roots were counted two weeks after the experiment was begun.

Method of treatment.	Average number of roots per cutting.	Increase over controls caused by treatment.
Controls	11·9 ± 0·6	
Ehtylene	16·2 ± 1·2	4·3
Heteroauxin	23·1 ± 1·5	11·2
Ethylene and heteroauxin	40·5 ± 2·3	28·6

Following are some data obtained from these experiments. The average number of roots per cutting is given, with the probable error.

It seems impossible to explain these results on the theory that ethylene acts in the same manner as a growth hormone. It will be seen that the ethylene alone increases the number of roots by 4·3, and the heteroauxin alone increases it by 11·2. If the ethylene acts in the manner of a growth hormone, the ethylene and heteroauxin together could not increase the number of roots by more than 15.5, or the sum of the two preceding figures. Nevertheless, in this experiment the increase was not 15·5 or less, but 28·6. It appears, therefore, that ethylene cannot be acting directly to stimulate root formation, but that it must in some way cause the growth hormone to become more active.

In none of the above experiments can the ethylene have acted in the same manner as a growth hormone. It seems probable, therefore, that all the effects of ethylene on growth are to be explained, not as direct effects of ethylene alone, but as effects of ethylene on a growth hormone.

Pigments of Cotton flowers. Part II. Uppam. *Gossypium herbaceum*. By K. Neelakantan, T. R. Seshadri and R. H. Ramachandra Rao. (*Proc. Indian Academy of Science*, Vol. II. No. 5, Section A, pp. 490 to 498). Petals of flowers of the *Uppam* variety of cotton, collected from the Central Farm, Coimbatore, were used by the authors, for an investigation into the nature of the pigments present. Formerly Perkin had done similar study on petals which he seems to have obtained from North India, and it is interesting to note that the present work is

an advance on Perkin's findings. Perkin reported the presence of Gossypitrin as the main component, with small quantities of iso-quercitin. The present authors however find, that while the presence of gossypitiin as the main component is confirmed, a good amount of quercitin and small quantities of a new glycoside and of gossypetin, are also present in the pigments; the authors have employed for the alkali colour reactions, buffer solutions of varying pH values from 6·8 to 11·0 and these have served to bring out clearly the differences between the two substances gossypitrin and gossypetin, and therefore helped to establish the presence of both these different compounds in the pigments.

A detailed further report on the new glycoside—which is different from gossypitrin and quercimeritrin is promised and will be looked forward to with interest.

M. R. B.

An analysis of the influence of season on photosynthesis in the tropics. By B. N. Singh and K. Kumar. (*Proc. Ind. Acad. Sci.*, Vol. II, No. 5—Section B, pp. 437 to 457). The paper sets down the record of an extremely systematic investigation into the effect of season on the photosynthesis of radish leaves collected from plants, which to supply material right through the year, were planted at successive intervals of fifteen days. Some of the interesting information obtained from the experiments, may be classified under the following heads, which, in fact, represent the lines of attack of the problem.

(1) Variations in the intensity of assimilation in *different seasons*, under *one set* of external factors—(a temperature of 29°C, light 28650 M. C. and Co_2 0·049 gm. per 100 c. c). There is a decline in the photosynthetic rate, from cool January to the spring in March and from March to the midsummer in June, with the coming in of winter in October there is a rise in assimilation. (2) Seasonal assimilation under *varying sets* of environmental factors. It was again seen that there was a decline in intensity of assimilation during the summer months, but increased temperature between 29—37°C is efficient in increasing assimilatory activity during this period. An increase however of illumination and carbon dioxide concentration, is more effective in increasing assimilation, during winter than during summer months. (3) *Morphological and structural changes.* The radish plants undergo changes with the season, the height de reases, the weight of radishes diminishes (from 8 lb. to ¼ lb) and total leaf becomes less, as we pass from winter to summer. (4) *The chlorophyll content* runs paralelled to the assimilatory capacity and is highest during winter and lowest in summer.

In general, photosynthesis and plant vigour are more in evidence in winter, than during summer in spite of the increase of light and temperature during the latter period. It is also interesting to find that respiratory activity is very low during the summer months and the authors suggest that the leaves adapt their structure and function according to the intensity of the external factors present.

M. R. B.

Gleanings.

Giant Tobacco. Tobacco plants as tall as trees are among the strange vegetation of the lower Andian country now being investigated by an expedition from the University of California, under Professor T. H. Goodspeed. One of the tremendous growths measured by Professor Goodspeed was sixty feet high. The expedition is engaged primarily in a search for wild relatives of the common cultivated tobaccos, to be used in hybridisation experiments. Seeds of many other plants, however are being collected. (*Sc. Supp.* Vol. 82, 21, 38, p. 7.)

On the incidence of tuberculosis in the offspring of tuberculous parents. In a total of 564 matings and 2480 offspring the proportionate incidence of tuberculosis among the offspring was found to be in the following ratios by mating types,

the incidence in the offspring from matings in which neither parent was tuberculous being taken as 1: Both parents tuberculous, 4·3; father tuberculous, mother not, 1·7; mother tuberculous, father not, 1·6; neither parent tuberculous, 1. These results suggest the inference that a person is, on the average, about four times as likely to have tuberculosis if both his parents had it than if neither parent had. Such analysis of the material as it has so far been possible to make fails to disclose any factor other than heredity playing an insignificant role in producing the observed differential distribution of offspring incidence of tuberculosis by mating types, in the present material. (*Science*—Vol. 82, No 2136, page 840.)

A Recipe to clean walls. A French patent gives a composition of 455 parts of corn flour, 40 parts of copper sulphate and 5 parts of Alum mixed with boiling water, for use in cleaning dirty walls, paints etc. (*A. E. B. in Sc. Amer.* Sept. 1935, p. 152.)

That garlic odour! × × × × A lasting remedy for offensive breath and odours seems at hand. Even the long lingering odour of garlic yields to treatment devised by Dr. H. W. Hoggard and L H. Greenbey of Yales Laboratory of Applied Physiology. The breath can be immediately and completely got rid of, by washing the teeth and tongue and rinsing the mouth with a solution of chloramine. The chlorine liberated in the mouth, reacts chemically with the essential oils and deodorises them. × × ×......... (*Sc Service—Sc. Am.* Sept. 1935.)

Sugar Statistics Sir T. Vijayaraghavacharyar gives the following interesting statistics as regards the benefits derived from the sugar industry :— Value of sugar made from cane in 1935, Rs. 12 50 lakhs. Out of this amount the price for cane is Rs. 600 lakhs; the charges for transport of canes Rs. 120 lakhs; wages of labourers Rs. 200 lakhs; and salaries of educated staff Rs. 50 lakhs. The Indian sugar Industry provides employment for about 1500 graduates and scientific men, 7500 other educated staff and 200000 skilled and unskilled labourers. (*The Mysore Economic Journal* Vol. 22, No. 1, p. 33.)

Self-imposed famine in India. When a people's diet takes a vicious path of its own towards impoverishment, it causes a graver mischief than any act of cruelty inflicted by an alien power Such has unfortunately been the case in our province. Rice has been our staple food from which we have for generations received a part of our health, strength, energy and intelligence. But curiously enough, especially among the upper class of our community, a fatal epidemic of foolishness has become prevalent which allows this principal foodstuff of ours to be depleted of its precious nourishing element. Rice mills are menacingly spreading fast extending throughout the province an unholy alliance with malaria and other flagbearers of death robbing the whole people of its vitality through a constant weakening of its nourishment We not only boil away an essential amount of nutrition from our daily ration of rice but also use elaborate machinery to polish off its skin which contains its most vital gift.

This is a self-imposed form of famine deliberately welcomed by a people who had already been suffering from the scarcity of milk and that of ghee of a non-poisonous kind.

There had been, I am told, some proposal to check the progress of this fatal evil through the intervention of legislature. I am glad that it failed, for the people must not be treated like eternal babies carefully protected by its appointed nurses from its own utter silliness. It is only for ourselves to exercise our intelligence for choosing our food which must be wholesome and sustaining. It is for the people themselves to realize that in the long run it is not cheaper to substitute the callous force of machinery for the indigenous rice-huller, oil press and grind mill for crushing the wheat.

Physical vigour born of healthy meals is valuable, not only for itself but for its power of enhancing one's earning capacity. Then again, we have to take into account the immense importance of our rural economic life whose course has been cruelly obstructed by the iron monster robbing our village women of some of their natural means of livelihood and the labouring class of its right to gather its simple living out of the gleanings from the people's own green field of life. It has gone on for long, this tampering with the time-honoured irrigation of living, in this country causing large desert tracks of privation in our villages.

Would it be too much to expect a body of volunteers to form a league whose members should take a solemn vow to use *dhenki*-hulled rice for their meals not allowing its nourishment to be stupidly thrown away by wasteful cooking? Could they not realize that it is the perpetuation of a national calamity to which most of us are daily helping by instituting in our homes an insiduous method of suicide? (Dr. Rabindranath Tagore in the *Harijan*.)

AGRICULTURAL JOTTINGS

BY THE DEPARTMENT OF AGRICULTURE, MADRAS

1. **Cotton Strains.** Cotton, though occupying only 6·3% of the total cropped area, forms one of the important crops of this Presidency on account of Madras producing more long staple than any other part of India and also of the relatively high value got for the produce. It is mainly grown on the black soils.

There are five distinct tracts in this Province, each growing a commercial type entirely different from one another. The Department of Agriculture has opened farms in each of them and is making intensive studies for more than a decade with the object of improving the local varieties. As a result of these investigations it has evolved more paying strains, the seeds of which are being multiplied and distributed to the cultivators.

For the Tinnevelly tract comprising the districts of Madura, Ramnad and Tinnevelly, two strains viz. C. 7 and A 10 were isolated from Karunganni cotton at the Koilpatti Agricultural Research Station. They are being grown over 70,000 acres. The former type is being grown in the southern taluks of the tract while the latter is preferred in the northern part. They have a mean fibre length of ⅞" with a ginning percentage of 30 as compared with ¾" staple and a ginning percentage of 27 of the local mixture. In yield it is as good as the local Tinnies. The lint fetches a premium of Rs. 5 per candy of 500 lb. It is declared suitable to spin 24's to 30's warp yarns.

Recently another strain called Koilpatti 1 has been isolated. It has an efficient plant body, a ginning percentage of 31 and a spinning value of 28's to 32's. It is able to withstand better the untimely February rainfall which causes a high shedding of buds and bolls in the other strains. Its average yield is therefore higher. The distribution of the seed was started only recently.

Cambodia Co. 2 is the strain recommended by the Department for cultivation in the Cambodia tract. Though it thrives best only on red and mixed soils, it is able to tolerate wide range of climatological conditions. It is a vigorous type with broad leaves and big bolls and is being grown over 75,000 acres. There is a very great demand for its seeds, which often secures a premium of 40% over the bazaar rate. It has a staple of 9/10" and ginning percentage of 35. It gives an increased yield of 15% over the local unselected type. It is suitable to spin 28's and is offered a premium of Rs. 8 per candy of lint.

For Bellary and Anantapur districts—called Western tract in commerce—strain H. 1 evolved at the Hagari Agricultural Research Station has been found to be very suitable. It is being cultivated over an area of 200,000 acres. Its

staple length and the ginning percentage are ⅞" and 29 respectively. Compared with the local Jawari cottons its ginning percentage is higher by 3%. Its lint fetches a premium of Rs. 12 per candy of 50 lb. It is capable of spinning 26's to 30's yarns.

In the Northerns tract, seeds of strain N. 14 was under distribution for a long time. It has a staple of ⅞" and can spin up to 40's. It is highly valued by commerce on account of its fine and strong fibre. In certain years it fetched the very high premium of Rs. 70 over the local market rates, and was cultivated over more than 30,000 acres. But of late its acreage has fallen on account of its low ginning percentage and its unsuitability to soils other than red and mixed. Attempts are already on foot to evolve a strain suited to the black soils of this tract.

'Cocanadas' is the name given to the cotton grown in Guntur, Kistna, Nellore and Godavari district. Unlike other cottons, it has a deep brown lint and is much wanted by the traders for its keeping colours fast. As a result of the breeding work done at Guntur, a strain No. 171 has been isolated. It has a length of ⅞" and a ginning percentage of 26. It yields 10% more than the locals. It spins up to 26's while the cotton from which it was selected spins only 16 to 18's. Its distribution has been started only recently. It is hoped that it will be grown over very large areas before long.

2. **Dry farming practices in Ceded Districts.** In parts of the Bombay Presidency where the average rainfall does not exceed 22 inches per annum it has been shown that as much as fifty per cent. of the rainfall may be lost to the crop. This is due to what is common experience viz. that quantities of rain water run off the land, some is lost by the drying effect of the sun, and a further quantity is lost through natural causes inherent in the physical qualities of the soil.

In recent years special attention has been given to this problem in the Ceded districts. The main effort has been directed towards increasing by means of improved tillage firstly the penetration of rain water and secondly its retention by the soil. In the case of clay soil penetration of rain water is generally far less than is generally believed. In a type of black cotton soil in the Coimbatore district it has been shown, for example, that rain water does not enter the soil to a greater depth than 2 ft. from the surface. Similarly, in Egypt on land irrigable from the Nile it has been shown that if certain of the land is flooded for 30 days it is possible for the water to penetrate only 2 ft. in depth.

The problem in the dry tracts of this Presidency therefore, as elsewhere, is to examine the efficiency of dry farming practice in respect of water penetration and retention. In the Ceded districts the ryots generally are well aware of the usual methods of arresting excessive run off of water, but such are expensive. Further, over large areas there is no material with which to erect embankments against rainwash.

The Department of Agriculture have overcome this difficulty by designing a special implement which is capable of throwing up a field bund. The implement which costs Rs. 7 -8—0 can be drawn by medium sized bullocks.

At Sanganakallu 3½ miles from Bellary, an area of land was ploughed at the beginning of the present season with an iron plough costing Rs. 32. This is in contrast to the local practice of tillage with a country plough or *guntaka*. It is claimed that the use of this improved implement results in more even tillage and therefore better conditions for the penetration of water. Before the sowing of cotton the land was protected against rain wash by the erection of bunds. Part of a holding was treated in this way and part was cultivated by local methods. The harvest of cotton has started and the first pickings show that the improved dry farming practice has given about fifteen per cent. more kappas than the local practice. Similar plots have been laid down in several centres of

demonstration work in Bellary and Anantapur districts. In some cases there are early sown crops and in others *hingari*. The results will be known later.

3. **Improved seed of Ragi and *Gante* (*cumboo*) for the Vizagapatam District.** On the Anakapalle Agricultural Research Station, two strains of early Ragi Nos. 525 and 355 have been evolved, the former having been found to grow well in the late season also. During the past 3 years, these have been tried and distributed where found promising. In these three years, No. 525 gave over 139 plots, an increase in yield, over the local bulk, of 273 lbs. (24·7 %) of grain valued about Rs. 5—8—0 per acre. Judging from the results of the plots in the different taluks the strain appears to be more suited to the southern taluks of the district than to the northern ones, the degree of suitability being also dependent on the seasonal conditions. Wherever paddy is to be planted late this strain will prove very useful, and ryots are advised to replace the local seed with it as early as possible.

Ragi No. 355 has during the past 3 years given on an average over 89 plots an increased yield of 224 lbs. (19·2 %) of grain per acre valued Rs. 4—8—0 over the local bulk. The success of this strain in the different taluks has been more varied, any delay in planting this strain, which is earlier than the other, affecting the yield. Where paddy is intended to be planted early, this would be a suitable strain to take up.

Next to ragi, *gante* (*cumboo*) forms an important part of the ryots' food in the Vizagapatam District. It occupies over 2 lakhs of acres in this district, which possesses the largest gante growing area in the Telugu districts. During the past 3 years two new varieties of gante one from Bombay and another from the Punjab were tried at Anakapalle and released for trial in the District during the last season.

In spite of the adverse season, the Punjab gante gave, on an average of 9 plots, an increased yield of 288 lbs. of grain (39%) valued about Rs. 5—12—0 per acre over the local. The Bombay gante gave an increased yield of 221 lbs. (30%) valued Rs. 4—4—0 per acre over the same number of plots. If the strains continue to prove superior in further trials, as it is hoped they will, they will be of great help to the ryots of the southern taluks of the district especially the coastal ones where the rainfall is lower, and where this crop is largely grown in preference to Ragi, or which requires heavier rain to cultivate. (By Courtesy of Director of Agriculture.)

Crop and Trade Reports.

Cotton Raw Receipts at Presses and Spinning Mills.

Loose Cotton.	Bales (against an estimate of 445,600 bales).	Figures for corresponding period in previous year.
1—2—35 to 20-12—35.	455,523.	580,022.
„ 27-12—35.	458,876.	584,031.
„ 3—1—36.	462,558.	586,712,
„ 10—1—36.	466,742.	588,722.
„ 17—1—36.	470,479.	592,005.
„ 24—1—36.	472,935.	597,224.
„ 31—1—36.	478,597.	599,497.

Pressed Cotton.	Receipt in Mills.	Export by Sea.	Import by Sea.
1—2—35 to 20-12—35.	290,319.	133,844.	43,218.
„ 27-12—35.	292,099.	134,454.	43,571.
„ 3—1—36.	297,183.	139,759.	47,017.
„ 10—1—36.	300,788.	141,324.	47,199.
„ 17—1—36.	304,446.	142,842	47,855.
„ 24—1—36.	310,306	143,339.	49,049.
„ 31—1—36.	317,371.	147,224.	49,525.

(Bale = 400 lbs.).

Paddy—Final forecast report—1935-36. The average of the areas under paddy in the Madras Presidency during the five years ending 1933-34 has represented 13·5 per cent. of the total area under paddy in India. The area sown with paddy in 1935-36 is estimated at 11,000,000 acres as against 10,828,000 acres for the corresponding period of last year and the finally recorded area of 11,055,587 acres in 1934-35. The present estimate falls short of the final area by 0·5 per cent. and the area of 11,381,660 acres in an average year by about 3·4 per cent. 1,403,000 acres have been reported as sown since the last December forecast was issued. The extent so sown was large in Ganjam (125,000 acres). East Godavari, Chingleput (118,000 acres), South Arcot, North Arcot, Madura (103,000 acres) and Ramnad (152.000 acres). The area sown in December and January was greater than that sown in the corresponding period of last year by 286,000 acres or by about 26 per cent. The area under second crop paddy is expected to be generally below normal. The harvest of paddy is in progress. The yield is expected to be normal in Kistna, Guntur, Kurnool, Bellary, Cuddapah, North Arcot, Madura, and the Nilgiris, slightly above normal in South Kanara and below normal in the other districts. The yield was the lowest in Ganjam (84 per cent.). The seasonal factor for the Presidency works out to 94 per cent. of the average as against 96 per cent. in the season and crop report of last year. On this basis, the yield works out to 98,090,000 cwt. of cleaned rice. This represents a decrease of about 1·6 per cent. when compared with the estimate of 99,622,000 cwt. in the season and crop report of last year. The yield in an average year is estimated at 107,776,000 cwt.

The wholesale price of paddy per imperial maund of 82-2/7 lb. as reported from important markets towards the close of January 1936 was Rs. 2—12—0 in Nellore and Erode, Rs. 2—10—0 in Vizianagaram and Cuddapah, Rs. 2—9—0 in Nandyal, Rs. 2—8—0 in Berhampore, Rs 2—6—0 in Madura and Tinnevelly, Rs. 1—11—0 in Kumbakonam and ranged from Rs. 1—15—0 to Rs 2—4—0 in the other markets. When compared with the prices reported in the previous month, these prices are stationary in Berhampore, Vizagapatam, Erode and Tinnevelly and are lower by 27 per cent. in Kumbakonam and Salem, 24 per cent. in Trichinopoly, 18 per cent. in Vellore, 15 per cent. in Cuddapah, 14 per cent. in Madura, 9 per cent. in Cocanada, 8 per cent. in Negapatam, 6 per cent. in Guntur, and 2 to 4 per cent. in the other markets.

Sugarcane—Third or final report, 1935. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1933-34 has represented 3·7 per cent of the total area under sugarcane in India. The area planted with sugarcane up to the 25th December 1935 is estimated at 131,120 acres. When compared with the area of 122,470 acres estimated for the corresponding period of last year, it reveals an increase of 7·1 per cent. The estimate of the previous year was less than the final area of 125 310 acres by about 2·3 per cent. The present estimate of area exceeds the second forecast by 5,730 acres. The excess occurs mainly in Ganjam, West Godavari, Guntur, Bellary, South Arcot, North Arcot, Salem, Coimbatore, Trichinopoly and South Kanara. The increase in area in comparison with the final forecast of 1934 occurs in all districts outside Ganjam. Guntur, Anantapur, Salem, Coimbatore, Madura and Ramnad. The harvest has just commenced and normal yields are expected in all districts outside the Circars (Guntur excepted) Anantapur. Salem and Coimbatore where the yield is expected to be below normal. The seasonal factor for the Presidency is calculated at 97 per cent of the average as against 91 per cent in the previous year. On this basis, the yield is estimated at 360,410 tons of Jaggery as against 320,940 tons estimated in January 1935, an increase of 12·3 per cent. The final estimate for 1934-35 was 351,100 tons.

The wholesale price of Jaggery per imperial maund of 82-2/7 lb., as reported from important markets towards the close of December 1935 was Rs. 6—14—0 in Nandyal, Rs. 6—6—0 in Tuticorin, Rs. 5—15—0 in Kumbakonam, Rs. 5—12—0 in Calicut, Rs. 5—9—0 in Madura, Rs. 5—4—0 in Bezwada, Rs. 4—15—0 in Masulipatam, Guntur, Bellary and Cuddapah, Rs. 4—8—0 in Rajahmundry, Rs. 4—7—0 in Salem, Rs. 4—6—0 in Vellore, Rs. 4—4—0 in Cocanada and Ellore, Rs. 4—2—0 in Vizagapatam, Rs. 3—14—0 in Coimbatore, Rs. 3—13—0 in Trichinopoly and Rs. 3—1—0 in Tinnevelly. When compared with the prices of the previous month, these prices reveal a fall of 19 per cent in Ellore, 14 per cent in Vizagapatam, Masulipatam, Nandyal and Trichinopoly, 13 per cent in Coimbatore, 10 per cent in Guntur, 9 per cent in Bezwada, 8 per cent in Bellary, 5 per cent in Rajahmundry and 4 per cent in Cocanada and a rise of 4 per cent in Cuddapah and Tuticorin. The price remained stationary in Vellore, Salem, Tinnevelly, Kumbakonam and Madura.

Groundnut—Final report—1935. The average of the areas under groundnut in the Madras Presidency during the five years ending 1933-34 has represented 48·2 per cent. of the total area under groundnut in India. The area sown with groundnut in the Presidency in 1935 is estimated at 2,492,500 acres. When compared with the corresponding estimate of 2,323,300 acres for the previous year and the actual area of 2,350,934 acres according to the season and crop report of the previous year, the present estimate reveals an increase of 7 3 and 6 per cent. respectively. The estimated area for this year is less than the normal area of 3,317,650 acres by about 25 per cent. The increase in area is general outside Ganjam, Vizagapatam, East Godavari, Bellary, Anantapur, Coimbatore, the South (Tanjore excepted) and Malabar. The increase is marked in the central districts (Coimbatore excepted). The area in Bellary and Anantapur has fallen from 412,600 acres to 292,000 acres due mainly to an increase in the area under cotton and other dry crops. The harvesting of the summer and early crop of groundnut was finished by October. The harvesting of the winter or main crop is proceeding. The crop is expected to be below normal in Vizagapatam, Guntur, Cuddapah, South Arcot, the Central districts, Tanjore, Tinnevelly and Malabar. The seasonal factor for the Presidency works out to 92 per cent. of the average as against 78 per cent in the previous year according to the season and crop report. On this basis, the yield is expected to be 1,143,400 tons of unshelled nuts as against 920,260 tons in the previous year, an increase of about 24 per cent. The yield in an average year is estimated at 1 660,990 tons.

The wholesale price of groundnut shelled per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of December 1935 was Rs. 5—14—0 in Tinnevelly Rs. 5—13—0 in Cuddalore, Rs. 5—8—0 in Vizagapatam, Rs. 5—5—0 in Berhampore, Rs. 5—4—0 in Negapatam, Rs. 5—2—0 in Guntur, Rs. 5—0—0 in Vizianagaram and Cocanada, Rs 4-15 0 in Nandyal and Cuddapah, Rs. 4—12—0 in Adoni, Vellore and Salem, Rs. 4—11—0 in Coimbatore, Rs. 4—8—0 in Madura and Rs. 3—12—0 in Ellore. When compared with the prices for October 1935, these prices reveal a rise of 21 per cent. in Cuddalore, 1 per cent. in Ellore, 5 per cent. in Vizagapatam, Guntur and Nandyal and 4 per cent. in Cuddapah and a fall of 14 per cent. in Coimbatore, 7 per cent. in Berhampore, 6 per cent. in Vellore, 5 per cent. in Vizianagaram, 4 per cent. in Madura and 3 per cent. in Adoni and Salem. The price remained stationary in Tinnevelly.

Gingelly—Intermediate report—1935-36. Sowings of late gingelly are in progress in most districts. The condition of the crop is generally satisfactory.

Mr. T. LAKSHMANA ROW—A Short Sketch.

Tandalam Lakshmana Row, Retired Assistant Agricultural Chemist, was born on 16th December 1880 in Kumbakonam. His father Mr. T. Gopala Row was one of the earliest graduates of the Madras University and as a veteran educationist, his name is still remembered in the Kumbakonam College. Born of an aristocratic Tanjore Mahratta family, Mr. Lakshmana Row was the youngest of seven brothers, who all attained high positions in the Revenue and Judicial departments.

Young Lakshman had his early education in the Town High School, Kumbakonam, and then after his F. A. in the Kumbakonam College went to the Presidency College, Madras for his B. A., under Principal Stone and Professor Jones. He graduated in 1902, but did not seek employment for some years, entering service for the first time in 1906, as Librarian in the office of the Government Botanist, Madras. When this officer, who was none other than Dr. C. A. Barber, was transferred to Coimbatore, as Economic Botanist, Mr. Lakshman Row also accompanied him and was appointed Librarian at the Agricultural College. In 1910, however, he was drafted on to the Agricultural Chemistry Section, where he spent the remaining period of his service. He continued as an Assistant in the Chemistry section till 1922, when he went on 2 years' leave to England at his own expense and took a diploma at the Imperial College of Science, London. On his return in 1924, he was gazetted as Assistant Agricultural Chemist, a rank he occupied to the date of his retirement.

Unassuming and of a retiring disposition, Mr. Lakshmana Row never cared to be in the lime-light, but those who have worked with him, know what a methodical and precise worker he was, with an amazing degree of patience and perseverence. With a natural distaste for publicity, he refrained from rushing to print, otherwise there would have been a lot more of publications to his credit, than there are now. During his term as Assistant Agricultural Chemist, he was responsible for a number of investigations, chief among which may be mentioned (1) Methods for improving jaggery manufacture at Hospet (2) Investigations into the betel vine disease at Vellalur (3) The preliminary work connected with the lay out and start of the soil moisture plots at Coimbatore (4) Investigations into the methods of estimating the PH values of soils and (5) The soil survey of the Lower Bhavani Project areas.

Outside office, Mr. Lakshmana Row was a man of varied and wide tastes and hobbies. A scholar with a choice collection of favourite authors, an artist with a taste for music and paintings, an enthusiast in photography, radio and mechanics, he still found time to take long open-air walks, which constituted his only exercise.

Careful and scrupulous in his manners and behaviour, he was affable and amiable and earned the love and respect of all he came in contact with.

In the early years he was connected with the growth of the Officers' Club, of which he was the Secretary and once he has been Treasurer of the Madras Agricultural Students' Union. In his retirement, we wish him all health and happiness.

[*Ed. M. A. J.*]

College & Estate News.

Association of Economic Biologists. The Annual Meeting of the Association of Economic Biologists was held on 25th January, after the usual tea and photo. The annual report was read and several amendments to the rules were passed. It was decided (a) to reduce the rate of subscription from Rs. 3 to Rs. 2 per annum (b) to have an additional Vice President from among the members outside Coimbatore and (c) to have an Assistant Secretary and Treasurer. The following office bearers were then elected. *President*: Mr. V. Ramanathan, *Vice Presidents:* Mr. K. Krishnamurthi Rao and Dr. T. Ekambaram, *Assistant Secretary and Treasurer:* Dr. S. Kasinatha Iyer and *Committee Members:* Mr. K. Ramiah and Dr. E. K. Janaki Ammal. The retiring President Mr. K. Ramiah delivered an interesting and illuminating address on " Genetics in Rice ".

A Fire Accident. We are sorry to inform our readers that a fire broke out at the Residence of Mr. N. L. Dutt, Second Cane Breeding Officer at Chettipalayam, on the 1st inst. Immediately on rceeipt of news, Mr. B. M. Lakshmipathi and Mr. D'Cruz, rushed to the spot and managed to keep the fire under control till the arrival of the Fire Engine from Coimbatore. The people of surrounding villages, the officers of the Sugarcane Station, and a number of estate residents, rendered great help in extinguishing the fire. It would appear, that the rear verandah of the bungalow caught fire while the immates were fast asleep upstairs, and long before they could realise that something was amiss, the flames had almost enveloped them. Mr. Dutt with singular presence of mind rescued his wife and children, and pluckily rushed out into the open before the flames glutted his sleeping apartment. We congratulate him and his family, on their providential escape.

Visitors. Rao Bahadur D. Ananda Rao, Director of Agriculture, Madras, Rao Bahadur B. Viswa Nath, Ag. Director of Imperial Research Institute, Pusa and Mr. Kapoor, Economist, I. C. A. R., visited Coimbatore during the last week of January.

I. C. A. R. The Director of Agriculture. Mr. K. Ramiah, Mr. M. C. Cherian, and Mr. C. Vijiaraghavan visited Delhi in connection with the sub-committee meeting.

Students' Corner. *Tour.* Students of 2nd year returned from their fortnight's Educational Tour in the Circars on the 20th January.

On 7th, 8th and 9th February, Students of class iii were on tour and visited Puliampatti, Gobichettipalayam and Tiruppur.

On 6th Students of class ii were on Tour and visited Gobi where irrigation experiments are being carried out by the department.

Students' Club. A general body meeting was held under the presidency of Mr. R. C. Broadfoot, Principal of the College when a resolution of condolence over the untimely demise of the student, late Mr. K. D. Dharmarajan was moved from the chair and was passed all standing—students and the staff.

The Secretary was authorised to convey the resolution to the bereaved parents.

Sports. With the Annual Club Day coming off on the 22nd instant the activities of the club were at their height. Various indoor games, inter tutorial football and hockey matches, inter class Parnell cup hockey matches have been in progress. A full account of the club day activities will appear next month.

Literary. Essay and elocution competition have been conducted the subject for the former being "Why I have chosen agriculture as a career" and for the latter, "The Value of Hostel Life".

Weather Review (JANUARY 1936).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	1·6	+1·4	1·6	South	Negapatam	0·0	−1·7	0·0
	Berhampore*	1·7	+1·4	1·7		Aduthurai*	0·1	−4·4	0·1
	Calingapatam	0·1	−0·2	0·1		Madura	0·1	−0·5	0·1
	Vizagapatam	1·0	+0·5	1·0		Pamban	0·3	−1·9	0·3
	Anakapalli*					Koilpatti*	0·1	−1·4	0·1
	Samalkota*	0·3	+0·2	0·3		Palamkottah	0·1	−1·4	0·1
	Maruteru*								
	Cocanada	1·2	+1·0	1·2					
	Masulipatam	0·0	−0·2	0·0	West		0·4		
	Guntur*	0·0	−2·9	0·0	Coast	Trivandrum	0·0	−4·3	0·4
						Cochin		−0·7	0·0
Ceded	Kurnool	0·0	−0·2	0·0		Pattambi*			
Dists.	Nandyal*	0·0	−0·1	0·0		Taliparamba*			
	Hagari*	0·0	−0·1	0·0		Kasargode*	0·0	−0·2	0·0
	Bellary	0·0	−0·1	0·0		Nileshwar*	0·0	−0·2	0·0
	Anantapur					Mangalore	0·0	−0·1	0·0
	Cuddapah	0·0	−0·5	0·0					
Carnatic	Nellore	0·0	−1·7	0·0	Mysore	Chitaldrug	0·0	−0·3	0·0
	Madras	0·2	−1·2	0·2	and	Mysore	0·0	−0·2	0·0
	Palur*				Coorg	Mercara	0·0	−0·2	0·0
	Palakuppam*	0·0	−1·1	0·0					
	Cuddalore	0·1	−1·5	0·1					
						Kodaikanal	0·2	−2·8	0·2
Central	Vellore	0·0	−1·4	0·0	Hills.	Coonoor	1·5	—	1·5
	Hosur cattle farm*					Ootacamund*			
						Nanjanad*	0·2	−1·1	0·2
	Salem	0·0	−0·3	0·0					
	Coimbatore	0·0	−0·6	0·0					
	Coimbatore Res. Inst.*								
	Trichinopoly	0·4	−0·4	0·4					

Meteorological Stations of the Madras Agricultural Department.

Summary of Weather Conditions. Dry weather prevailed over the Peninsula for the greater part of the month. Scattered falls of rain occurred in the North Madras coast and South East Madras during the later half.

Maximum temperatures were above normal at most places in the Peninsula while the minimum temperatures were markedly below normal in and around Punjab.

Rainfall was in large defect in the Peninsula and locally in excess in the North Madras coast.

Chief falls reported were :—

Berhampore	...	...	1·3"	
Vizagapatam	...	...	0·7" on the	19th.
Cocanada	...	...	0·9" „	20th.
Coonoor	...	...	0·5" „	21st.
Coonoor	...	...	0·8" „	28th.

Weather Report for the Research Institute Observatory.

Report 1/36.

Absolute Maximum in shade	91·8°F.
Absolute Minimum in shade	58·8°F.
Mean Maximum in shade	87·8°F.
Departure from normal	+ 1·8
Mean Minimum in shade	64·4°F.
Departure from normal	Nil.
Total Rainfall	Nil.
Departure from normal	0·48
Heaviest fall in 24 hours	Nil.
Total number of Rainy days	Nil.
Mean daily wind velocity	2·5 M. P. H.
Mean humidity at 8 hours	73·8%
Departure from normal	- 1·7
Total hours of bright sunshine	295·8
Mean daily hours of bright sunshine	9·5

Summary. Rainfall for the month was nil and below normal. Maximum temperature was above normal. Lowest minimum recorded was 58·8°F on the 7th instant.

A. S. R. & D. V. K.

Departmental Notifications.

Retirement. Mr. M. Ramaswami Pillay, Sub Assistant in Paddy will retire with effect from 16—9—'36, and Mr. G. R. Venkatachalapathi Raju, A. F. M., Coimbatore from 1—1—'37.

Promotions. Mr. A. Gopalan Nair and Mr. T. G. Anantarama Iyer to be substantive II Grade. Mr. M. Satyanarayana, to be substantive IV Grade. From III to II Grade: Mr. K. Govinda Nambiar. IV to III Grade: Mr. K. Avadainayagam Pillay without prejudice to his Gazetted appointment. V to IV Grade: Mr. M. K. Swaminatha Iyer and Mr. A. Krishnaswami Iyer. Mr. P. S. H. Narayanaswami Naidu, substantive IV Grade.

Leave. Mr. G. K. Subramania Iyer, l. a. p. for 4 months.

New Appointments. Upper Subordinate III Grade, with effect from 30-1-1936. Mr. K. M Narayanan, B. Sc. Ag., Assistant in Chemistry. Mr. K. Meenakshisundaram, Agricultural Section, IV Circle. Mr. V. V. Rajagopalan, Assistant in Oil Seeds. Mr. P. C. Sahadevan, Assistant in Chemistry.

Manager's Notice.

Subscribers and members are requested to remit their dues at an early date. In the absence of instructions to the contrary the March issue of the journal will be sent by V. P. P., to those whose subscriptions have expired, by December and whose remittance has not been received so far.

M. A. S. U.

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Editorial.

Consolidation of Holdings. The economic disadvantages of excessive fragmentation of holdings are well recognised and need no reiteration. Such fragmentation is due both to the laws of inheritance customary among Hindus and Mohamadans and to the method by which such laws are carried into effect with regard to division of property amongst the heirs; in fact, where fields vary in fertility and in the facilities they command with regard to irrigation and drainage due to the situation, the partition will not be equitable unless each field is divided among the heirs. Where a large proportion of the agricultural lands are cultivated by tenant cultivators who have no right to the property as in Madras, such fragmentation of holdings is associated with the worse evil--fragmentation of cultivation as well. Whether prevention of fragmentation of holdings will also prevent fragmentation of cultivation is a point that can be answered only when actual data are collected, on the acreage a cultivator usually takes up, which will of course vary with the tracts. We find from the report of the Royal Commission on Agriculture that such data are not available for any province except the Punjab.

While the evil of fragmentation is recognised all over the country, only in a few of the provinces like the Punjab, the Central Province and Bombay, have any attempts been made to overcome it. In the Punjab, sub-division has been checked to some extent by imposing

restrictions on alienation and in the case of certain grants, by the limitation of succession to a single heir. A purely permissive measure has been proposed in Bombay according to which an "economic holding" after registration as such, is to become impartible and not liable for further sub-division. There are certain inherent objections to the Bombay proposal. In the first place it will not be an easy proposition to determine the size of the economic holding. It will have to vary according to the tracts and the systems of cultivation adopted. For example, what is termed an economic holding in Tanjore will be obviously different from a similar holding for the Ceded districts. Secondly, the determination of the economic holding obviously defies the existing social systems. Thirdly, the economic holding principle is likely to be more availed of by the well-to-do classes and it might even affect adversely the poorer classes. The Royal Commission examining all the evidences submitted to it, came to the conclusion that there was no other practical suggestion to prevent the evil of fragmentation than by interfering with the laws of inheritance.

The only way of overcoming the evil effects of fragmentation is to consolidate the holding (i.e. to bring together scattered fragments of land into one compact block) by mutual agreement among the parties concerned. The only two Provinces where such consolidation has been tried with a certain amount of success are the Central Province and the Punjab. In the Central Province a Consolidation of Holdings Act has been passed in one of the divisions, by which if the majority of the people in a village assent to it a scheme will first be drawn up by a special officer appointed for the purpose, and when it is confirmed it becomes binding on all the land owners in the village. In the Punjab however, the consolidation movement is entirely in the hands of the Co-operation Department. There is continuous propaganda carried on by specially trained co-operative officials to educate the ryots about the advantages of consolidation. The movement is said to have been very successful and we are told that several lakhs of acres have thus been consolidated at a nominal cost of about Rs. 2 per acre. In so far as Madras is concerned there has not been any move in the matter. It is possible that the methods found successful elsewhere may not prove equally successful in Madras. The Punjab has the special advantage of possessing vast tracts of homogeneous soil, where land tenure is simple. In Madras, in addition to big differences in the quality of soils in the different parts, the tenure is also very complicated. But the problem is, we believe, so important that it is time some attempt is made to introduce this much-needed reform. In this connection we cannot but repeat the opinion of the Royal Commission regarding the matter. "Fragmentation of holdings is in many parts of India one of the most important of the factors tending to prevent agricultural improvement. There seems to be common agreement that its evil

effects are so great that the administrations should not rest content until a remedy has been found. We strongly hold that the initiation should not be left to the spontaneous action of the right-holders but that the state should do propaganda work, should explore the whole situation and should also bear the cost at the initial stages. Progress may be slower where tenures are more complex or qualities of soil more varied, but difficulties should not be allowed to become an excuse for inactivity."

The other Provinces and states are no doubt keenly watching the progress made in the Punjab regarding consolidation. Among the native States, Mysore had recently appointed a special Committee to determine the nature and extent of sub-division and fragmentation of holdings in the state and the practicability of bringing about a consolidation of the same. The commiteee after examining the scheme and measures adopted in Punjab and the Central Province has put forward certain recommendations which the Government has published inviting public opinion on them.

We had an occasion to point out in this journal some time ago, that unlike Madras, several Provinces were proposing to spend a portion of the grant given to them by the Government of India towards village improvement work on some agricultural schemes such as stock breeding, distribution of improved seed of crops, well boring etc. The Punjab had programmed to spend about 2 lakhs out of a total grant of 8½ lakhs on agricultural improvement works which included a lakh for a scheme on consolidation of holdings. But we understand that at a recent meeting of officials and non-officials convened to determine how the subvention should be spent it has been decided that all the 2 lakhs should be spent on the scheme of consolidation. It shows what great importance they are attaching to this agricultural reform.

Will it be too much to expect Madras to take some action in the matter? We now know very much more about rural indebtedness in Madras since the appointment of a special officer to make an enquiry and report about it. Cannot a similar thing be done with regard to the possiblities of consolidation of holdings?

The first question that might be considered would probably be the appointment of a special officer preferably one with revenue and co-operation experience with the object of making a special study of the question and gather information on the present state of fragmentation of holdings at least in certain parts of the Province, where the evil of fragmentation is excessive. This special officer might be later deputed to visit the Punjab, the C. P. and Bombay to study the actual conditions under which the scheme of consolidation has

worked successfully so that a beginning might be made in some part of Madras where similar conditions are known to prevail.

Agricultural Officer for the India XI. We congratulate Mr. C. Ramaswami, Assistant Director of Agriculture, Cuddalore, on his inclusion in the Indian Cricket team that is to tour England during this summer. Mr. Ramaswami has already earned his name on the tennis court as a doughty champion of Madras and his progress with the Indian cricket team in England will be watched with eagerness and interest by all his friends and well wishers.

BROADCASTING VERSUS TRANSPLANTING OF RICE

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and

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Introduction. Of the two practices, direct sowing and transplanting, the latter is by far the more important and it may be said that wherever facilities for transplanting obtain people will prefer it to broadcasting. It would be safer to say that four-fifths of the rice grown in the world is transplanted, and almost all countries like Spain, Italy, Japan, etc., where the highest acre yields are recorded adopt transplanting. Drilling is to a certain extent replacing the practice of transplanting owing to labour difficulties of transplanting as in California. In Italy where also labour is very expensive they have evolved a transplanting machine which can be worked in the puddle.

Broadcasting is usually confined to tracts where the water availability is uncertain and the season is not always dependable. The fact that the yield per acre is definitely higher for a transplanted crop is well recognised though the reason for this increase has not been explained satisfactorily by experimental evidence. It has been sometimes explained that transplanting acts in a way like root pruning; the injury to the root system stimulating the growth of the sub-aerial portion and resulting in increased tillering. It is also stated that transplanting gives a shock to the plant which stimulates better growth and better tillering and consequently better yield. This shock theory cannot, however, be accepted since seeds actually dibbled in lines evenly, yield as much as, if not better than a transplanted crop. In a small-scale experiment conducted some years ago at the Paddy Breeding Station, Coimbatore, comparing actual dibbling with transplanting in the case of two varieties, one a short duration variety, 3½ months, and another a medium duration one, 5 months, the dibbled plots gave decidedly higher yields than the transplanted. Similar results have been obtained in other parts of India and even outside India. If a satisfactory and practical method of actually dibbling the seed directly in the puddled field can be evolved there is no doubt that such a practice should prove an advantage over transplanting. The comparative merits of direct sowing and transplanting have formed the basis of experiments conducted at several of the Departmental Research Stations and the present note deals about such an experiment conducted at the Paddy Breeding Station, Coimbatore, for three seasons 1931—32 to 1933—34.

The Experiment. The experiment was carried out with three strains as shown below:—

Season.	Strain No.	Duration of strain.
1931–32	Co. 1	5 months.
1932–33	Co. 1	5 ,,
,,	Co. 8	6 ,,
1933–34	Co. 9	4 ,,

A row of fields was divided into a number of 2½ cents plots and they were all very uniformly prepared. At the usual time of sowing the nursery, every alternate plot was well levelled and the sprouted seed was sown in it directly as uniformly as possible, and on the same day the nursery for the transplant plots was sown separately. At the time the seedlings were ready they were planted in the alternate plots in the row. The broadcasted plots were not interfered with in the beginning and at the time of transplanting, the plots were given a weeding and the seedlings were thinned out sufficiently so that the number of plants in an unit area was the same in both broadcasted and transplanted plots. At the time of harvesting, the plots were divided each into two equal halves so that the arrangement of the plots was of the A B B A fashion. Each sub-plot was now harvested separately and the yield data analysed statistically.

Besides determining the final yield, the number of plants per unit area (half a square yard), the number of earheads in it, length of the panicles, height of plants, etc., were also recorded from random samples in the different plots so that an explanation could be offered to account for the final yield differences. The sampling was done by putting in an iron ring, half a square yard in area at different spots chosen at random in all the plots and taking notes of the plants inside such rings. All the data obtained are given below.

Year.	1931–32		1932–33				1933–34	
Variety.	Co. 1		Co. 1		Co. 8		Co. 9	
Treatment.	Brordcasted.	Transplanted.	Broadcasted.	Transplanted.	Broadcasted.	Transplanted.	Broadcasted.	Transplanted.
Yield of grain in lb. of the experimental area—Total of 11 repetitions.	372	392	278	352	221	313	210	288·5
Acre yield in lb.	2,706	2,851	2,022	2,560	1,607	2,276	1,527	2,098
Yield expressed as percentage of mean.	98·6	102·7	88·2	111·7	82·4	119·6	84·0	115 8
Percentage standard error of the mean.	2·6		3·8		3·2		3·0	
Number of ears per unit area (½ sq. yd.).	133 ± 6.6	101 ± 3·24	105 ± 3·60	96 ± 2·25	114 ± 3·22	103 ± 2·01	67 ± 2·61	84 ± 4·45
Mean length of panicle in cms.	—	—	19·0 ± 0·05	20 54 ± 0·06	17·88 ± 0·13	21·07 ± 0·14	20·2 ± 0·09	19·6 ± 0·08
Mean height of plants in inches.	—	—	81·9 ± 0·80	88·4 ± 1·0	82·3 ± 0·84	97·8 ± 0·89	—	—

The season was a bit late in 1931-32 and the plants in the broadcasted plots which were infested by thrips (*Thrips oryzae*) could not make any headway in the early stages. This prevented proper thinning being carried out with the result the number of plants per unit area in the two treatments, broadcasted and transplanted, happened to be different. In the next two years there was no such difficulty experienced, but still the number of plants in the broadcasted plots was slightly more than in the transplanted plots.

Discussion of Results. In 1931—32, the yields of broadcasted and transplanted plots were almost the same. For the reason mentioned previously the broadcasted plot could not be thinned and it had nearly twice the number of plants per unit area as compared to the transplanted crop. The lower population density in the latter was made up by increased tillering. In the second year, the population density was only slightly more in the broadcasted plot in both the varieties, Co. 1 and Co. 8, and still the difference in yield in favour of the transplanted crop has been considerable. Though the number of ears per unit area has been slightly in favour of the broadcasted plots, the individual panicles of the transplanted crop have been definitely bigger in both the varieties, and the bigger ear has been the main cause for the difference in yield. In the trial with the *kar* variety, Co. 9, in 1933—34, the advantage of transplanting has again been brought about. Though it is usually considered that the two treatments cannot make a big difference with regard to short duration rices, under Coimbatore conditions in a normal season, transplanting appears to be better than broadcasting even in a short duration crop. Unlike in the two other varieties, Co. 1 and Co. 8, the increased yield of the transplanted crop in this case has been brought about mainly by the larger number of ears per unit area, the size of the ear in the two treatments not being different.

Other observations. *Root System.* Observations were made on the root system of some plants in the two treatments. It was found that in the broadcasted crop, the plants did not have such a well developed root system as in the transplanted crop. The transplanted plants had a more extensive and deeper root system and this is probably the reason for the broadcasted crop always having the tendency to lodge. In the transplanted crop the tillering and rooting zone is about an inch or two below ground level, and in the broadcasted crop, the seed having been dropped on the surface, the root system is more on the surface and it does not give sufficient anchorage to the plant.

Flowering, duration and height. Though in the experiments the sowing of the seed in the broadcasted plot and the sowing of seed in the nursery for the transplanted crop were done on the same date, the flowering of the transplanted crop was sharp and uniform, while in

the broadcasted crop, it was uneven and delayed. The harvest of the broadcasted crop could be made only a day or two later than the transplanted crop.

In 1932—33 where height measurements were recorded the transplanted crop in both the varieties, Co. 1 and Co. 8, was always taller in growth than the broadcasted crop, the differences between the two being significant. Although no actual weighments of straw yield were made, it was apparent that the quantity of straw was more in the transplanted crop.

Economics of the two treatments. While in the case of the broadcasted crop there is some extra expense due to the higher seed rate used and to the extra weeding that has to be given, in the case of the transplanted crop, the extra expenditure due to the raising of the seedlings and transplanting the same is very much more considerable. As the figures given below show, the value of the increased yield obtained from a transplanted crop not only covers the additional expenditure but leaves a clear extra profit. This net extra profit is about Rs. 14 in the case of Co. 1, Rs. 18—8—0 in the case of Co. 8 and Rs. 8—8—0 in the case of Co. 9 (*kar*).

	Co. 1.	Co. 8.	Co. 9	
	lb.	lb.	lb.	
Extra yield of grain per acre due to transplanting.	538	669	571	
	Rs.	Rs.	Rs.	
Value of this extra produce.	19—3—6	23—14—0	13—14—6	
Extra expenses incurred with transplanting.				Rs.
Cost of raising seedlings.				5—0—0
Transplanting charges.				2—4—0
Total.				7—4—0
Extra expenses in the broadcast crop.				
Cost of excess seed.				0-12—0
Cost of one additional weeding and filling gaps.				1—2—0
Total.				1-14—0
Net extra expenses in transplanting over broadcasting.				5—6—0
	5—6—0	5—6—0	5—6—0	
Net profit by transplanting	13-13—6	18—8—0	8—8—6	

Summary. The practice of raising a nursery and transplanting the crop in rice is always preferred to the direct sowing of the seed in the field. That the latter practice still obtains in some tracts is due to the uncertain seasonal conditions and inadequate irrigation facilities.

The comparative merits of the two practices were investigated into by regular experiments at the Paddy Breeding Station, Coimbatore. Three varieties of rice, a short duration *kar* crop, a medium duration *samba* crop, and a long duration *samba* crop were experimented with, and in every case transplanting was definitely found to be very much better than direct sowing. In the *samba* varieties the increased yield was brought about mainly by the bigger size of the earheads in the transplanted crop and in the *kar* crop by the bigger number of earheads per unit area. Even after allowing for the extra expenditure involved in the raising of seedlings and the transplanting of the same, the value of the extra produce obtained in the transplanted crop was enough to leave a clear net profit of Rs. 8 to Rs. 14 per acre.

CROP-CUTTING EXPERIMENTS.

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Introduction. One of the three factors necessary for estimating the yield of a crop, namely the "Standard or Normal yield", is admittedly susceptible of considerable improvement in many Provinces in India. The Agricultural Department in each Province is responsible for fixing the "Normal Yield" per acre for the several crops in each district. The estimate of normal yield is based mainly upon a system of crop-cutting experiments made over a number of years. Under this system, plots of land of average quality are selected in each district by the officers of the Agricultural Department and the crops grown upon them are cut and weighed before them. The results of the experiments are reported to the Director of Agriculture, who on a careful scrutiny of all the reports received by him, and after comparing with such other information as may be available from trade statistics, settlement investigations and the like, fixes the "Standard Yield" of each crop for each district. The estimates are generally revised if necessary at the end of five years.

Reliance on crop-cutting experiments, the methods adopted in carrying them out, and the agency employed in conducting them have all been subjects of criticism in the past. But no satisfactory alternative basis for calculating the normal yield has been suggested. The Board of Agriculture after a very thorough examination of the point in 1919 and 1924 recommended that crop-cutting experiments must remain the basis of estimates of "standard yield". As regards the methods in use, criticism is mainly directed to two points, viz. that the number of experiments are too few to be capable of generalisation over a large area and that they depend for their success entirely on the ability of the officer to select the average field from a large number of fields growing different varieties of a crop at different stages of maturity. In selecting the fields, it is very difficult to give proper weight to

fields of very little or no productivity, and even in a normal year such fields are by no means rare. These factors make accurate selection very difficult. Another important defect of this method of selection, even though it is done on a large scale, is that it is not possible to make any generalisations from such experiments, because there is no method for determining the probable error of the results of such a "Deliberate selection" as opposed to a "Random selection". Naturally we fall back upon the method of "Random sampling" to give us a satisfactory estimate of the average yield per acre of any crop of a district.

Number of Samples. Suppose the average yield per acre of a crop from a sample is y with a standard deviation of s. Also suppose the total number of fields under that particular crop in the district is N, and that experiment is conducted in n out of the N fields. Then $X = \frac{N}{n}$ is called the sampling factor. Let $K = \frac{1}{X}$; then from a well-known formula the average yield per acre of the district is $y \pm s\sqrt{\left\{\frac{1-K}{n}\right\}}$ Hence n the frequency of the sample depends upon (1) the dispersion of the yield of the crop about the average yield; (2) the total number of fields growing that particular crop; and (3) the degree of accuracy expected as measured by the probable error of the yield. Generally 'N' is very large compared with n and so K $(\frac{n}{N})$ is insignificant. Therefore for a given degree of accuracy $\sqrt{n}$ is directly proportional to s (the standard deviation). If the crop selected is of such a character that its coefficient of variation $\left(100 \times \frac{\text{standard deviation}}{\text{arithmetic mean}}\right)$ is small, the number of crop-cutting experiments necessary to give a fairly accurate result is also small, and vice versa.

To take a specific case, the coefficient of variation of the yield of rice in the several divisions of Bihar and Orissa was found to vary from 40 to 60 with an average of 48 in Mr. Hubback's crop-cutting experiments of 1925. Suppose that the standard error of any forecast should be 5% of the average

$$\therefore\ 100 \times \frac{s}{\sqrt{n} \times y} = 5$$

i.e. $\frac{V}{\sqrt{n}} = 5$ where V is the coefficient of variation

$$\text{if } V = 40 \qquad n = \frac{40^2}{5^2} = 64$$

$$\text{if } V = 60 \qquad n = \frac{60^2}{5^2} = 144$$

Taking the upper limit, if 150 crop-cutting experiments are made per district the standard error will be about 5% of the average yield. If

225 experiments are made the standard error will be $\frac{60}{\sqrt{225}} = 4\%$. Hence to be on the safe side it is desirable to take 200 to 250 samples to get a reliable estimate of the aveiage yield per acre.

Thus from a knowledge of the coefficient of variation of the yield of any crop the number of experiments for each sample can be fixed. For most of the important crops the coefficient of variation is not likely to be more than 60, and hence it is enough if for each crop 200 to 250 cuttings are taken to find the average yield.

Technique of Selection. It is very well-known that even in the compact area of a district, several crops are grown on a variety of soils of varying degrees of fertility, under different methods of cultivation (irrigated or unirrigated, intensive or light, and so on). To add to this there is a large number of varieties of the same crop including those of improved seeds. So if we want to divide the district into a number of homogeneous areas and then take a number of samples from each variety of the crop, the work will be impossible because it is almost certain that such homogeneous areas cannot be delimited with sufficient accuracy, and even then the number will be too large for investigation. Even if this could be done, it would be impossible to compute the probable error of such experiments. (In certain crops like cotton, where the cassification of separate varieties is of very great importance, the sampling method for different varieties could be applied).

So it is necessary to devise a method by which every unit in the aggregate shall have an equal chance of being included. In the present case the question arises whether the unit for sampling should be a village or a field comprised in a survey number. The defect of the former method is that we can select only a few villages, and in each village a selection has again to be made of a few plots. This restricts the scope for all varieties of plots being represented in the sampling because there is a very high correlation between the soil conditions, varieties of the crop and their yields in the same village as compared with the whole district. In fact this method is analogous to selecting 50 strips of 10 units each instead of a random sample of 500 units. (Vide F. L. Engledow and G. U. Yule, " The Principles and Practice of Yield Trials Section "). It is shown there that the standard deviation of such a method is greater than that of the random sampling method. So the best way of doing the whole thing is to prepare a list of the fields in the district, arranging the villages in a geographical or alphabetical order and in each village arranging the fields according to the survey number. Now suppose there are 'N' fields (i. e. total of the survey numbers) and we want to select 'n' fields. Let X be the nearest integer of the fraction $\frac{N}{n}$. Now mark the 1st, $(x+1)$; $(2x+1)$, $(3x+1)$; ....and so on, numbers in the ordered list and conduct

the crop-cutting experiments in those fields. Of course it is better to select the first field at random rather than selecting the first survey number of the first village in the list. Also if it is felt necessary, there is no objection to arranging the villages according to the different soils and types of cultivation. But this should be done before the selection is made from the ordered list. Thus due weight will be given to tracts where a large percentage of fields grow the same crop, and also the different types of cultivation and soil receive adequate representation. Of course if in the survey number selected the particular crop is not grown the nearest field growing the crop should be taken.

After the selection is made the adequacy and the randomness of the sample can be tested by computing the area of the crop of the whole district from the sample, as well as the land revenue assessed; and seeing whether the estimates differ from the facts by more or less than the computed probable error. A rough test can also be made by dividing this big sample into two, one comprising the sample of odd numbers and the other the even, and observing how the results of these two sub-samples agree.

Mr. J. A. Hubback in his "Sampling for Rice Yield in Bihar and Orissa" observed that the practical difficulties involved in the above method require a method which is more automatic in the distribution of sampling in time and space. The only difficulty pointed out by him is the necessity to find out the date on which the crop in each field would be ready for harvest and to arrange a visit to the village on that date. The alternative method suggested by him was to divide a tract of nearly 1,000 square miles into 12 regions. "It is necessary to fix 12 centres spread as evenly as possible over the area and to put down against each centre the day on which sampling is to be done. These days should be spread evenly over the period of harvest. The sampler should go out a fixed distance in one direction and, circling round, return from another direction, so that it is secured that he covers approximately the same area on each day. He could cut one sample from each field, where he finds harvesting in progress. He will be able ordinarily to get from 30 to 40 samples in a day when the harvest is in full swing and 10 to 20 when it is slack." Any officer could do the work quite well.

But this method will not be strictly random on account of the fact that however carefully the dates for sampling may be arranged, all the different units have not an equal chance of coming into the sample because only those fields which are homogeneous in certain respects will be ready for harvest during a particular period and so the fields having different varieties produced on different soils under different conditions will not all stand equal chance. Hence the random sampling method proposed above is the best, provided arrangements can be

made for the investigators to visit those particular fields when they are just ready for harvest.

Details of the Experiment. After selecting the field the next question is whether the average yield per acre of the whole field should be found out or again only a random sample of that crop should be taken or any other method should be adopted. The objection to finding out the average yield per acre of the whole field is that all the survey numbers are not of the same extent in area, and secondly that it is impracticable considering the cost and time that it takes. An alternative method is to follow the "*Danabandi*" (appraisement) system of rent payment followed in some parts of the country. It consists of the tenant cutting a small area where the crop is thinnest and the landlord where the crop is heaviest, mixing the two together and taking the result as a fair sample. But Mr. Hubback's objection to this method is that it presupposes that the true mean lies midway between the highest and lowest sample, which is very rarely found in practice. He says that in fact this method always gives an over-estimate. An alternative method is to take 4 or 5 samples from each field and find the average of those to get the average yield of the field. But it was found by experience in Bihar and Orissa that even four samples instead of one are not worth while, because in the great majority of cases they do not differ among themselves enough to affect the mean or the standard deviation of the whole set of samples (vide Hubback's "Sampling for Rice Yields in Bihar and Orissa," p. 9).

Hence it is enough if a small plot of land (the area being constant for all sample) is chosen at random, under definite directions, and the average yield of that is taken to typify the field. For example the sampler may be instructed to go to the centre of the boundary of the field parallel to the line in which the harvest is proceeding and take a plot of area at a few steps say 5, 10, from that place. Of course for finding the absolute yield of that field that sample is not sufficient; but in the case of a large number of samples positive and negative errors cancel and the average yield of the whole district will not be disturbed. In this connection the question, what is the reasonable area of the plot of land for each sample, arises. In Mr. Hubback's experiment a mechanical device, by which a plot of land in the form of an equilateral triangle comprising an area of 13200 of an acre is formed, was used. But it is very difficult to find the area and to weigh the quantity of grain produced in such a small plot very accurately and even small errors in measurements and weights magnify the errors of the average yield per acre. So from practical considerations it will be better if a plot of land whose area is 1150 or 11100 of an acre is chosen, i. e. a plot of ground in the form of a square of side 10 yards or 7 yards roughly.

Conclusion. To sum up, the standard yield of any crop in any district can be estimated by cutting the crop on about 200 to 250 plots

of land each of area 1,100 or 1,50 of an acre, the plots being selected on a purely random basis. Of course every effort should be made to compare the results of the experiments with such other information as may be available from trade statistics, settlement investigations and the like.

ON SOME PARASITES FOUND IN ASSOCIATION WITH THE STEM WEEVIL PEST OF COTTON IN SOUTH INDIA (*Pempheres affinis*, F.) & THEIR ROLE IN ITS BIOLOGICAL CONTROL*

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and
V. MARGABANDHU, M. A.

It is now over two decades since the cotton stem weevil *Pempheres affinis*, F. began to attract some attention as a fairly important pest of cotton in South India, and the first paper (1) on the general features and life history of this insect was published by the senior author. Since then, this pest, which was in the early years confined chiefly to the cambodia variety of cotton, has been directing its attentions to other cottons and distributing itself fairly widely in the cotton areas of South India. As a consequence, special attention has had to be paid to this insect along with other important pests of cotton viz., the boll worms, and even the help of legislation had to be resorted to for the control of these important pests. Side by side, intensive studies on the different aspects of the problems connected with this insect have also been carried out by the Government Entomologist and by a special staff appointed for this work by the Indian Central Cotton Committee. The peculiar habits of this weevil as an internal feeder in its destructive stages have made it rather difficult to tackle it by means of the ordinary mechanical or insecticidal methods of control, and it is found that the only possible means of keeping the pest under some control must mainly consist of prophylactic cultural means and plant sanitation, the breeding of resistant strains of cotton. or by trials in biological methods by the use of parasites or predators. Speaking of biological methods and the agencies in that direction, with which this paper is mainly concerned, it is needless to add that it is in the first place essential to find out whether any such natural enemies really exist and get some definite ideas regarding their potentiality before any control measures in that direction are attempted. With a view to find out if the pest is subject to the attacks of such natural enemies the authors have been carrying on some work, and the experience of the past two or three years has so far shown that this insect, unlike some of our common insect pests, is not commonly subject to

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parasites or predators, and till now studies in this direction have revealed the existence of only a few parasitic wasps in comparatively very small numbers associated with the developing stages of this weevil pest. These being the first definitely identified and reared records of insect enemies of this stem weevil, the authors have thought it desirable to present this fact in this short paper with the available systematic and biological notes gathered so far regarding these parasites and their role as natural enemies.

The Parasites. The parasitic insects so far found associated with the stem weevil number five in all, and appear to belong to two different families of wasps; of these five, two are braconids and the other three which are smaller in size belong to the well-known group of chalcid wasps. Of the two braconids the larger form appears to be a species of the genus *Spathius;* since only a few specimens have been secured, it is proposed to record the exact specific identification after sufficient material of the parasite is secured; Species of *Spathius* are usually found attacking the larvae of powder post beetles (Bostrychidae) found damaging stems of trees, wooden posts, bamboo framework etc.; one species of *Spathius*, *Spathius piperis*, W has been noted however from the Dutch East Indies as a larval parasite of a weevil *Lophobaris piperis* and Beeson and Chatterjee have recently noted (4) two or three species of *Spathius* attacking weevils of the genera *Camptorrhinus*, *Osphilia* and *Mecistocerus* attacking forest trees. The smaller braconid of which only a single specimen has been so far reared out is a species of *Microbracon* closely allied to *M. gelechidiphages* described by the senior author (5) as parasitic on the cotton boll worm.

Of the three chalcid wasps noted so far in association with the stem borer weevil, one is a *Eulophid* and appears to belong to the genus *Olinx*, F—a genus not recorded before from India. One of the other two appears to be a *Pteromalid* belonging most probably to one or other of the two genera *Pachyneuron*, W or *Hypsicamara*, F. The smallest of the three which has only been noted very recently appears to belong to the family Encyrtidae. It is proposed to describe these parasites as soon as possible in a separate systematic paper elsewhere.

The biggest braconid was found in very small numbers and was mainly obtained from dead plants kept for emergence of adult weevils from the early sown cotton crop during the end of December. Some of the adult wasps were found to possess only vestigial wings. Examinations in March showed stray cases of the pupae of this wasp enclosed in thin tough dirty white cocoons. The pupae were found in the tunnel, one for each host grub. The incidence is found rather negligible as far as noted, since not more than a dozen have been obtained so far.

In the case of the chalcids, though adult parasites of the Eulophid were obtained even from stems collected at the end of the season which

were kept for observation during August, September etc., they were prominent only during March and in fact, at the fag end of the season, when the dominant stage was found to be the grub of the parasite. Stray adults also were found *in situ*. In April all the stages were being obtained viz., grubs, pupae and adults, the former two obtained to a smaller degree. In stray cases just emerging adults were noticed from the stems. There were also cases where the adults were found dead *in situ*. It appears that only the grub stage of the pest is attacked and that only one parasite attacks a single host grub and these grubs are generally found parasitised in the earlier stage. The grub of the Eulophid is very minute and is generally found associated with the host larva and can be detected only after careful observation; such a grub taken pupated in a day or two. In the case of the Pteromalid the grubs are generally stout, grayish in colour, and tapering at the ends with the central region bulged up, and these are found singly in the tunnel of the host with absolutely no trace of the latter; and in all such cases the parasitic grub is found to be a fully fed one which, when separated and kept in a tube, pupates almost in a day or two. Before pupation the grub throws out faecal pellets around it in a circular fashion and after undergoing shrinkage pupates. The pupa is white in colour at the outset but changes to a brownish dark tinge after three or four days, and the adult emerges at the end of a week or seven days. In the case of the pupa the head and thorax are dark and the abdomen alone is white. These two forms appear to be ectoparasites and so can easily be detected in the tunnel made by the grub. The braconid also appears to be ectoparasitic. It is interesting to note that the Eulophid wasp has also been noted as a parasite of the cotton stem borer buprestid beetle *Sphenoptera gossypii* in the Ceded districts.

As is the case with many other insect parasites these forms appear on the pest more at the end of the crop season than at any other time; anyhow the effectiveness of these parasites depends upon the degree of incidence which may vary in different cases.

Biological Control of the weevil and suggestions in that direction. In investigating the possibilities of utilising these parasites in the control of the cotton stem weevil one very important point to remember is, that, unlike numerous other crop pests, especially caterpillar pests of sorts which feed exposed on the plants and which offer easy access to numerous enemies, this pest in its destructive stages is a borer, spending all its earlier life stages inside the stem of a plant which has a fairly hard bark. It is therefore clear that it is not all parasites which can attack such an insect, but only those which are specially adapted to reach the grub inside the stem that have chances of exercising any control over the developing pest; and even in such cases the success of the parasite depends a good deal on the particular stage of the host which is vulnerable, and the favourable stage of the plant when the

parasite can get easy access through the stem. The economic entomologist, who is anxious to adopt biological methods of control against this pest by using parasites, has therefore to carry out preliminary investigations more or less on the following lines to get some idea of the potentialities of such natural agencies.

A. Carry on breeding of parasites from borer infested cotton in the different areas to find out (a) the different kinds of parasites; (b) the comparative incidence and habits of parasites in relation to the pest and its stages for one or more crop seasons ; (c) the inter-relations and bionomics of the parasites themselves to find out if there occur any hyperparasitism, superparasitism or any such complexities which might interfere with the proper effectiveness of any of the parasites. It is not unlikely that a condition which may be called a parasitic complex might exist in the case of many pests as has been pointed by previous workers and by the senior author in his paper (9).

B. Study the parasites of other fairly common boring beetles or caterpillars, especially those of such weevils as the agathi weevil (*Alcides bubo*) the stem weevil attacking Gogu, Hibiscus and often cotton shoot (*Alcides affaber*) other species of weevils attacking lablab and other leguminous stems, the amaranthus weevil (*Lixus brachyrhinus*) and other beetles like the ground stem boring beetle (*Sphenoptera perotetti*), other borer beetles like Bostrychidae (powder post beetles), Ipidae (timber boring and ambrosia beetles), the longicorns like the coffee borer *Xylotrechus*, the mango borer *Batocera*) the fig borer (*Olenecamptus*) etc., and of boring caterpillars like the agathi stem borer (*Cossid*), the citrus shoot borer (*Arbela*).

The discovery of the alternate host plants which offer actual breeding facilities to this pest will also help not only in locating its haunts when there is no cotton in the field, but also to find out what parasites are found breeding on the insect in these alternate host plants. Ballard (2) makes the rather amazing statement that it has been found breeding in or feeding on many different plants and that it has been bred from the different plants not to speak of others on which the adult has been noted. Experiences of the writers and other later workers have however shown that though the weevil has been now and then collected from a few other Malvaceous plants besides cotton it has not so far been found actually breeding on any other plants except on Bendai (*Hibiscus esculentus*) to a small extent, on stray *corchorus* plants (3) and on Gogu (*Hibiscus cannabinus*). It has to be remembered that noting the adult of an insect on a plant and actually finding the same breeding on it (showing the grub and its other stages on it) are two different phenomena and one cannot conclude without sufficient evidence that the insect is breeding on it by merely noting the adult casually perching or mating on a plant. The study of the alternate hosts is to find out if there are any parasites common to any

of the above borer beetles and in any of the other host plants on this pest and if so whether any such parasites could be bred out in sufficient numbers artificially from two or more other hosts.

Information on items such as numerical, seasonal and reproductive aspects will also afford valuable clues as to the most promising methods of carrying on biological control. If predatory natural enemies are found available, the same lines of investigation as in the case of parasites may be pursued. It is needless to add that most of these lines of preliminary work will be found necessary in dealing with the control of any crop pest by the use of natural enemies, especially of insect parasites or predators and that the scientific values of such studies both to the systematist and the economic entomologist will be very great. A perusal of the very interesting paper by Pierce (6) on the valuable studies on the cotton boll weevil of Mexico and its parasites made during the past several years in the U. S. A. would give one an insight into the intricacies of the weevil pest problem and offer valuable suggestions for future lines of work against such pests. It may also be added that biological methods of pest control may not be quite successful in all cases, may be partially helpful in some, and not exclusively effective in most cases as may be seen by the perusal of a recent paper (7) by Sweetman on this subject where he gives a helpful list of all these categories.

In conclusion we can only quote the telling remarks of Dr. Thompson when he says (8) "Generally speaking, no one species of parasite or predator is likely to bring the host under control over the whole of the infested area. To produce this result, the introduction of additional species will usually be necessary, while in many cases, their efforts must be aided by the methods of agricultural, chemical or mechanical control". We would also commend to enthusiasts on Biological control Thompson's excellent papers on the subject before they attempt any serious work; for, in his own words "the idea of biological control has now become fashionable and is tending to degenerate into a kind of superstition or fad" (8). It has therefore to be reiterated that the study of the natural control of insects by biological methods and their proper utilisation demands a thorough study of the bionomics of the whole group of parasitic insects in relation to a single point which may be called the parasite complex of a pest.

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OMUM OR BISHOP'S WEED (*CARUM COPTICUM*)

BY M. R. BALAKRISHNAN, B. A., B. Sc. Ag.

Introduction. There is probably not a single household, rich or poor in South India, that does not keep a stock of omum water ready against any stomach ailment. As an infallible remedy against indigestion, its efficacy is known to all, and it is one of the few articles of medicinal use, that are sold by even the street hawkers.

The omum plant and its products have a glorious and ancient history behind them. In those early days of civilisation, when Egypt led the world, that country happened to be the sole source of supply to other nations. Later Afghanistan, Persia and other Mohammadan countries of Asia traded in this commodity and owed not a little to this plant, for their flourish and prosperity. It was in the 15th and 16th centuries that omum water came to be known in Europe for its therauputic properties, and references eulogising the excellence of the omum water received from Alexandria and Crete, can be found in the writings of Ponnet, who was physician at the court of King Louis XIV of France. This monarch whose name will go down in history for some famous gastronomic feats must have had,—perhaps at the instance of his physician—recourse to this carminative more than once in his life, to afford relief, when inordinate greed at the dining table made him feel for his indiscretion.

In India itself, omum water has been known and used from the earliest times. Bengal was the chief Province of cultivation and source of supply, but Ujjain—famous as the capital of the great Vikramadithya—has been known to produce the best quality of omum water from the middle ages.

Area and Soil. The total area under this crop in this country is about 100000 acres, of which Bengal occupies more than a third. Madras has about 5000 acres. Curiously there is an opinion that this crop does not thrive on fertile soils, and it is therefore often cultivated chiefly on the poorer types of soils. As a garden crop it is

grown almost throughout the country, in small areas here and there in between other major crops.

Cultivation. The method of cultivation is the same as that of other dry crops. It is said that manurial ingredients have a deleterious effect on the crop and it is therefore grown in a field where another crop had already been raised before, without any fresh application of manure. The sowing is done in October—November at the beginning of the north-east monsoon, which ensures a favourable start for the crop; as it however cannot stand water logging, sowing is done by dibbling the seeds 6 to 8 inches apart, on ridges which provide for surplus water draining away. About one Madras measure of seed suffice per acre, the yield from which ranges from 100 to 120 m. m. The duration of the crop is about six months, and during this period, if rains fail irrigation has to be supplemented from wells, otherwise the outturn is likely to be very poor.

The Plant. The omum plant is an erect and short annual, often about 1 to 2 feet in height and rarely growing beyond 3 feet; the whole plant is covered with minute hairs which give a bristling appearance. The leaves which are two to three pinnate have long stalks and look scattered; the inflorescence is an umbel, which shoots out in rays, the individual flowers being pure white and very pleasing to the eye in their snow white spread.

Omum products. The ovoid fruit is the product which is of the greatest importance and for which the crop is cultivated. It is occasionally used for culinary purposes and as an ingredient in chewing *pan*, but its chief use, is as a drug. Omum is used in medicine as the omum water, a product obtained by steam-distilling the fruit, the active principle being due to a compound called thymol—a—hydroxy derivature of benzene $C_6H_3 \begin{matrix} -OH. \\ -CH_3. \\ -C_3H_7. \end{matrix}$ and known by the popular name of *agowan oil*. This is a very costly oil ranging in price from Rs. 6 to Rs. 12 a pound, according to season and production and it is the mixture of this oil with water, that forms the omum water of the market. In addition to the oil which is about 25 to 30%, the fruits contain 16% of protein substances.

Trade. Ajowan oil enjoys a good amount of export trade although after the war the demand from outside markets has gone down. Before the war, out of a total of 8700 cwts. nearly 90% went to Germany, the balance being sent to America and Egypt. Latterly Japan has figured largely in the trade and it is said the oil is chiefly valued for the hydro-carbons-thymenes it contains, which are used for perfuming soaps.

Uses. The use of omum for culinary purposes has already been mentioned and as a corrective for indigestion the omum water is only

too well known. In addition, authorities claim for the omum products, aphrodisiac, diuretic and vermifugic properties. With myrobolans and rock salt it is made into a paste which serves as an expectorant for cases of sore throat. As a common household remedy against severe cold and heaviness of head, some omum moistened and crushed is packed up in a small cloth and used for inhaling.

Allied plants.- The *umbelliferous* cousins of the omum plant are all interesting and useful plants. Many of them are familiar to us either in the kitchen or through grandmothers' recipes. *Hydrocotyle asiatica* (Tam. *Vallarai*) *Carum caruui* (Tam. *Shimai shombu*). *Carum Roxburghiani* (Tam. *Ashanta omum*) *Ferula nathen* (Tam. *Perungyam*) *Pencedanum graveolens* (Tam. *Shadakuppai*) *Coriandrum sativam.* (Tam. *Kothamalli*) *Cumin ceynium* (Tam. *Shirakam*) are all members of *Umbelliferae*, the family to which omum belongs. Of these, *Hydrocotyle asiatica* has now assumed tremendous importance because, the oil of the fruit is considered to be a specific against leprosy and figures prominently in modern anti-leprosy treatment; it is also used in treatment of syphilis and as an anti-dote against mercury poisoning; *Carum carui* is used for pectoral piles while *Carum Roxburghiani* is administered to relieve bladder pain and as an antispasmoic in hiccoughs; *Ferula nathen* is supposed to be a nervine stimulant and in cases of hysteria and angina pectoris finds a liberal use. *Pancedanum graveolens* besides being well known for its carminative properties (it is from this *dhil* water is prepared) is also used as an emmenagogue. Coriander and cumin, are well known as indispensables in a tastily prepared menu, and they are supposed to correct anti-bilious tendencies.

CRAMMING WITHOUT A CRAMMER

One of our most successful poultry breeders is well known to have "no use of scientists". He is not alone. It is quite a common mistake to suppose that there is a world of difference between the scientist and the practical man. But if the scientist be not practical, he is a bad scientist, though he does not need to be a practical poultry farmer. Practical poultry men rarely realise what they owe to research workers, in breeding, incubation, and nutrition, who probably never handled a bird in their lives. Mendel, the discoverer of "Mendelism", worked on peas.

The latest scientific help for poultry men comes from a more unlikely source still—the psychologist. A study of the psychology of the hen in relation to hunger and appetite has revealed a trick or two worth knowing for the fattener.

Certain German scientists starved hens for 24 hours and then placed a heap of wheat. 100 grams, about 3½ ozs. in front of each one. When they stopped eating it was assumed they had satisfied their hunger; on the average, they ate 50 grams (1¾ ozs.) each, and left the rest untouched.

But when a larger heap was put before a hen in the same state of hunger, she ate about half as much again. So it seems that the more she sees, the more she

will eat, whether hungry or not. This result was also supported when other kinds of grain were used.

In another experiment a hen was allowed to eat from a pile of nearly half a pound of food until she was satisfied and stopped eating. The food left was then entirely removed with a brush and immediately replaced. She invariably made another attack on the food and ate some more. When she stopped the food was removed as before and immediately replaced, and she began to eat again. In many cases the hens dealt with in this manner ate as much as 67 per cent. more than satisfied them at the first meal.

Although such a process looks at first sight too fiddling and impracticable to be employed by fatteners, it is certainly not without its possibilities as a method of making birds cram themselves.

Another experiment which gave results that will surprise most poultry keepers was concerned with the difference in the surfaces on which the food was offered to the birds. When a hungry bird was put before grain on bare wood it ate on the average about 1½ ozs ; or slightly less, but when the food was placed on soft felt it ate more than twice that amount. When birds were given their choice between eating from a hard surface and a soft surface, they always chose the food on the soft surface once they had tried both.

Curiously enough, when this experiment was carried a step further, and smaller lots of grain were offered on a hard and soft surface together, neither sufficient to satisfy the bird, it ate up all the food on the soft surface, and left the other. But if more food was placed on the soft surface it was immediately eaten.

The conclusion to be drawn from this is that the jar which the bird gets from pecking on a hard surface is painful, if only very slightly so, and on that account the bird is content to eat rather less than to carry on jarring its beak on a hard surface.

Another experiment, in which birds were fed from a surface of putty showed by the marks on the putty that the hungrier the bird, (i e., the less she had eaten before being offered grain on the putty), the much harder she pecked, whilst a half satisfied bird made much shallower marks on the putty.

The size of the grains of food offered also had a remarkable influence on the amount eaten. When whole and cracked rice were offered (the cracked being about one-quarter the size) in similar states of hunger, the birds ate two or three times more by weight of whole rice than of cracked rice. Evidently picking up small pieces is so much more troublesome that the birds get "fed up" with it very quickly.

Various colours of lighting also appear to have an effect on the appetite-- yellow and red seem to stimulate it, blue and green appear to damp it.

Perhaps the most surprising experiment of all conceived the comparison between eating alone and in company. When a bird had eaten its fill and left the remaining food untouched, another bird, hungry, was put alongside the first. As soon as the hungry bird began to eat, the bird that had already had enough to eat began to eat again. In some cases a bird ate as much as 60 per cent. more after the hungry one had been brought in. Both birds ate still more when a third hungry one was added to the party. But when three well-fed birds had a fourth hungry one introduced, all three seemed to agree that they had had enough.

This last experiment does not appear to have much practical value, but some of the previous ones suggest lines that might be tried out.

For example, two battery houses containing similar quantities of birds of the same hatching might be compared, one with ordinary light, other with yellow or

red washed windows or lights at feeding time, and the amounts consumed measured.

Similarly, the effect of lining mash troughs with rubber could be compared. Every extra ounce of food consumed when cooped for finishing off increases the killing weight.

Frequent feeding of excessive amounts, and double feeding by removing the surplus after, say, 10–15 minutes, and feeding again, might be tried. It is possible that the labour involved would be more than paid for by the result. (*Feathered World*. No. 2427 December 27–1935).

Research Notes.

On the application of soluble manures—ammonium sulphate and super-phosphate—in swampy conditions for Rice

It is known that the fertilising principles nitrogen and phosphoric acid, in the soluble manures like ammonium sulphate and super-phosphate are immediately fixed in the soil soon after the application of these manures. But the conditions of rice cultivation are unique, quite unlike those for other crops as the rice crop is mainly grown under puddled and swampy conditions. Usually in the carrying out of manurial experiments on rice, elaborate precautions are usually taken against the leaching and washing out of manures by having separate bunds 1½' to 2' broad and 1' high and channels 2' wide and irrigation is carefully controlled to manured plots after the application of the manures. A simple preliminary experiment conducted at the Agricultural Research Station, Maruteru (C. R. Srinivasan 1929), indicated that there was no effect of ammonium sulphate beyond the area within which it was applied. Detailed experimental data were essential before any conclusions could be drawn and to arrive at a definite conclusion, an experiment was conducted at the Paddy Breeding Station, Coimbatore during the year 1933—1934.

Two fields that had strains Co. 1 and Co. 5 and planted in rows 1' apart between the rows and 6" in the row, were taken up for the experiment and the following manurial treatments were adopted.

1. Amonium sulphate at 100 lb. per acre.
2. Super phosphate at 200 lb. per acre.
3. Ammonium sulphate at 50 lb. per acre + 200 lb. super per acre.

Each field was divided into 3 portions one for each manurial treatment. In each of these portions, the manured and control (no manure) were arranged in AB. BA. plan giving 8 plots with each plot containing two rows of plants. There was no elaborate arrangement with regard to having bunds between the treatment plots except the demarcating line which was represented by a small mud elevation 2" to 3" high along the line. The manures were applied a month after planting for both the crops and the irrigation was controlled for a day or two at the time of application of the manure and no further precautions were taken afterwards with regard to irrigation and drainage. When the crop was ripe each individual line was divided into four equal parts and was carefully harvested and weighed. There were 16 replications for each treatment and the results are given in the table. It is seen that while the effect of manurial treatment was significant except in the case of super-phosphate (it has been found that there is practilally no response in paddy soils of Madras Presidency to phosphate manure), there is no significant response to manure in the no manure lines adjacent to manured lines showing there is no leaching effect with regard to ammonium sulphate applications.

We are indebted to Mr. K. Ramiah, Paddy Specialist at whose suggestion the expriment was carried out.

C. R. Srinivasan (1929). Mad. Ag. Station Report (1929—30)

a) Difference between manured and unmanured rows.

Treatment.	Strain.	Manured line. Mean of 16 repetitions.	Adjacent unmanured line. Mean of 16 repetations.	Mean Difference.	Standard error.	Mean difference. / Standard error.
1. Ammonium sulphate to supply 100 lb. per acre.	Co. 1	922·3	755·3	167·0	25·70	6·50
	Co. 5	677·4	569·4	108·0	15·10	7·16
2. Super phosphate to supply 200 lb. per acre.	Co. 1	714·5	743·5	29·0	11·40	2·54
	Co. 5	565·9	571·9	6·0	17·40	0·35
3. Super phosphate to supply 200 lb. + ammonium sulphate to supply 50 lb. per acre.	Co. 1	823·7	754·1	69·6	18·70	3·70
	Co. 5	599·0	559·7	39·3	14·35	2·73

(b) Difference between unmanured rows.

Treatment.	Strain.	Line adjacent to manures. Mean of 16 repitions.	Line away from manures. Mean of 16 repetitions.	Mean Difference.	Standard error.	Mean difference. / Standard error.
1. Ammonium sulphate to supply 100 lb. per acre.	Co. 1	740·0	755 5	15·5	29·00	0·57
	Co. 5	567·3	563·1	4·2	6·30	0·67
2. Super phosphate to supply 200 lb. per acre.	Co 1	746·3	743·5	2·8	14 00	0 20
	Co. 5	552 2	571·9	19·7	15·13	1·30
3. Supper phosphate to supply 200 lb. + ammonium sulphate to supply 50 lb. per acre.	Co. 1	770·5	754·1	16·4	21·42	0·77
	Co. 5	554·0	559·7	5·7	15·50	0·37

Value of 't' for P=·05=2.12

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ABSTRACTS

A method for making mechanical analyses of the ultimate natural structure of soils. By G. J. Bouyoucos. (*Soil Sc.* Vol. 40, No. 6, p. 481). Through a number of sieves, 10, 20, 40, 60, 80 and 100 meshes, soil is successively passed in the slaked state, the process being repeated, with the fraction passing through the first sieve being taken to the next one and so on. The several fractions retained on the sieves are weighed. All these together with the material passing through the finest sieve (100 mesh) were collected again, dispersed and mechanically analysed by the hydrometer method. At the finish, the dispersed material is again taken through the sieve procedure and the several fractions now obtained with

the dispersed soil are noted. Thus we get material passing with mere slaking and with dispersion and this gives a measure of resistant and non-resistant aggregates in the soil. M. R. B.

Cotton bark as a source of Rayon pulp. (*Imp. Inst. Bull.* Vol. XXXIII, No. 4, p. 446). Cotton pulp cut into small pieces and treated with alkali produced a pulp which had more ash constituents and less L-cellulose, than the material usually used for Rayon pulp, viz., bleached sulphite wood pulp. More drastic treatment with alkali to produce a finer pulp may be successful, but the yield will be too low for economical working. M. R. B.

The relation of soil treatment to the nodulation of pea-nuts. By H. B. Mann. (*Soil Sc.* Vol. 40, No. 6 p. 423). The paper is the result of an investigation of the effect of Calcium Carbonate and Sulphate, not so much on the final yield of nuts, but on the conditions of application and the effect on nodulation—an aspect which has not been well studied before. The experiment was done in pots, six treatments being studied, which included $CaCo_3$, $CaSo_4$, free sulphur, mixture of sulphur with $CaCo_3$ and with $CaSo_4$ and a control and three types of soils were examined. The results showed that (1) there was no correlation between growth of plant and nodulation (2) that the effect of lime on nodulation depends on the type of soil, being increased in soils poor in lime and getting reduced in soils rich in lime (3) Sulphur decreases nodulation and (4) that both Carbonate and Sulphate of lime are similar in their effects on nodulation. M. R. B.

The variation in the mineral content of vegetables. By J. Davidson and J. A. Leclerc. (*The Jour. of Nutr.* Vol. II, No. 1, p. 55). A paper that attempts to fill up the gaps of information on the mineral content of foodplants, which are necessary to make up a balanced ration. Samples of kale, broccoli, lettuce, cabbages and spinach were analysed for their ash content, and for potash, soda, lime, magnesia, phosphorus, sulphur, chlorine, manganese, iron and even copper, the examination covering the following factors which affect variation (1) variety, (2) place of growth, (3) type of soil, (4) fertilisers used, (5) dry or irrigated and if the latter, analysis of irrigation water used (6) insecticides used and (7) season. The results showed cabbage to be highest in phosphorus, kale in lime, spinach in magnesium and lettuce in potash. But, it was seen that each vegetable varied largely in its constituents due to the several factors, and each vegetable had its own range of variation for each particular constituent. Fertilisers and the nature of irrigation water used, seemed to contribute largely to the variation.

M. R. B.

The relation of soil erosion to certain inherent soil properties. By J. F. Lutz. (*Soil. Sc.* Vol. 40, No. 6, p. 439). A paper that studies the physical and chemical properties of several soils varying in their erosiveness, and the relation of these properties to erosion. Two soils were examined, one highly erosive and another comparatively non-erosive. Mechanical analysis and determination of aggregates showed that there is greater clay in the non-erosive soil; also it contains 15 to 16% more aggregates. Another important point is that these aggregates are in the form of large stable granules. The aggregates of the erosive soil in addition to being unstable, are dense and impermeable. A striking difference noted from the experience of previous workers, was the absence of any relationship between zeta potential and silica-sesquioxide ratio. Experiments on swelling and hydration, however, showed that hydration is a more important factor than charge, in determining the stability of colloid suspensions. The degree of hydration was measured by viscosity measurements. M. R. B.

Gleanings

State Aid for Marketing Crops. *The Coconut Industry Regulation Ordinance:* **(No. 18/1934)**—From the 1st of January, 1935, Regulations (No. 26 of 1934) concerning the export of copra came into effect. They provide that the moisture content must not be greater than 8 per cent, nor must defects and extraneous substances total more than 10 per cent, nor must there be more than 6 per cent mouldy plus immature pieces in a consignment. The defects mentioned comprise immaturity, insect attack, a smoky odour or discolouration by fire. *The Fruit Industry Regulation Ordinance.* **(No. 19/1934).**— Under this Ordinance the only crop dealt with to date has been bananas, the standards for which are laid down in Regulations (No. 25/1934) which came into effect on 1st January, 1935. Except for experimental purposes by the Department of Agriculture only the Canary (Cavendish) or Gros Michel varieties may be exported: they must be on the bunch, which in turn must not contain less than seven "hands," or combs: they must not be immature, over-ripe, damaged, bruised or broken, and must be free from disease. No bunch weighing less than 28 lbs. may be exported, and a prescribed standard of packing in a stout ventilated paper bag is laid down. A certificate of inspection under these regulations, which is given if the fruit is fit for export, is valid for 48 hours only. *The Bananas (Control of Exportation) Ordinance (No. 24/35).* Carriage of bananas by sea requiries special cool storage accommodation on ships and it is unreasonable to expect that any shipping company would instal such accommodation on their vessels unless a definite assurance of sufficient freight is forth-coming. In the complete absence of any local marketing organisation, Government has assumed this responsibility and has guaranteed freight on 25,000 bunches in 1935-6 and 50,000 bunches in 1936-7. A contract with a shipping company on these lines is now under consideration. Having given this guarantee it is obvious that Government cannot permit the export of fruit through any channel other than that on which public funds have been expended. Powers were therefore granted under the above Ordinance to prohibit the export of bananas except under licence being for such a period and subject to such conditions as may be directed. (*Extract from the Gold Coast Colony Agri. Dept.* for 1934-1935).

Packing of Nursery Plants. One grave error on the part of growers and sellers of tree plants is the carelessness and ignorance shown in packing for despatch to customers. How often do we see four years' work ruined in four days! Some people's ideas of packing young trees are most primitive. I have had bundles of trees despatched loose in the guard's van without any form of protection, with the result that all the outside trees were useless. This year I received trees packed in straw with canvas coverings, which when opened were so hot that it was hardly possible to put one's hand into the centre. Needless to say, the planting of such trees is merely throwing the good money and labour after the bad money and ruined material.

Thirty-five years ago, when nursery stock was scarce and relatively more expensive than it is to-day, we used to get large quantities of trees from Germany. Many a time we have been on tenter-hooks knowing that these trees had been despatched three weeks ago and not yet delivered. We need have no fear. With the excellent packing of the German nurserymen, the trees arrived at the end of three weeks as fresh and good as if they had come out of our own nursery. Their system of packing is now followed by at least one firm in Britain, but should be universal. Large shallow circular wicker baskets with handles were used and the young trees carefully packed with their roots in sphagnum moss, the heads

exposed to the air. Three or four stiff sticks were planted round the basket, and a tent-like arrangement with sacking protected the trees from too much air and sun on the journey. The baskets were charged for but returnable. As a matter of fact the cost was so reasonable, that we used to pay for and keep the baskets for own use.

Let us hope that our nursery-men will take this hint to heart, and cease to ruin their young trees that have taken so much time and anxiety to grow. (*Jour. of Forestry. Vol. 29. March 1935*)

AGRICULTURAL JOTTINGS BY THE DEPARTMENT OF AGRICULTURE, MADRAS

Cotton Pests in Bellary. In the 'Hindu' dated January 15, 1936, there appeared an alarming report that the 'Hingari' cottons round about Bellary were subject to a severe aphis attack called 'Karijigi' as a result of which 70 to 80% loss in yield was apprehended. An officer from the Entomology section, from Coimbatore was immediately deputed to visit the area, study the situation and take steps to combat the pest should it really be so serious. He traversed nearly the whole of the cotton belt in company with the Assistant Director of Agriculture, Bellary and found that there was absolutely no cause for alarm as the alleged pest nowhere existed on a scale depicted by the paper. Barring the presence of a few stainers and bollworms in isolated areas the cotton crop was generally found to be free from pest of any kind.

Bud and boll shedding was however found to be slightly more than normal in certain areas due to the drought conditions that had set in from November onwards. In certain tracts where drought conditions were acute immature bursting and mummifications of bolls known as '*Guggi*' in vernacular were also noticed.

Spraying Against Betel-vine Wilt Disease. Satyavaram village of Yellamanchili taluk in Vizagapatam district has been famous for its betel-vine cultivation for the last half a century. It exports betel leaves to distant places like Bombay Poona, Calcutta and Malabar. But in recent years a disease called 'wilt' has appeared resulting in the withering, wilting and eventually death of the vines. Damage has been, of late, so heavy, that gardens have been entirely swept away by the disease. The pre-disposing cause of this trouble appears to be the local practice of growing the same crop over and over for 4 to 5 years in the same plot though an interval of 2 to 3 years is allowed by leaving land fallow. The fungi causing the trouble are *Sclerotium rolfsii* and *Phytophthora Sp.* which are both soil inhabiting fungi. To demonstrate the methods of control a series of trials were laid out during the season in 1935. A definite number of rows were each treated with bordeaux mixture 1%. kerol ·07%, phenyl ·25%, and liming with an equal number of rows untreated for control. The above treatment was done alone and in conjunction with provision for drainage channels. The results observed so far have been satisfactory and the indications are that the above treatment in combination with provision for drainage was more successful than that without drainage which shows the great necessity for drainage in betel vine cultivation.

Money in Growing Flowers. In Madura District, flower growing especially of Chrysanthemum is mostly taken up by the Christian ryots round about Tirumangalam, Ammayanaickanur and Dindigul. They are small holders intelligent and industrious and make good profit per acre.

An enquiry conducted shows that they spend about Rs. 165 per acre from the raising of the nursery to harvest and the yield is about 20,00,000 flowers per acre and is sold at 0—4—0 a thousand which works out to Rs. 500. Deducting the cost of cultivation of Rs. 165, a net profit of Rs. 335 per acre is realised.

It is desirable that land owners near Madura, Tallakulam, Chockikulam and Pasumalai grow flowers as a trial on a small scale under the channel irrigation. They can easily sell their produce in Madura Town where there is a great demand. The area could be extended if they find the business paying.

Some ryots in Alankulam near Palamkottah in Tinnevelly District cultivate roses and jasmine in red loamy and gravelly soils and get very good profit per acre. Generally roses begin to give profitable yield from the 2nd year after planting to fifth year and yield about 225,000 flowers per year which sell at 0—3—0 a 100. Deducting the cost of cultivation etc. it is reported that about Rs. 270 net profit per acre, per year is obtained.

In the case of Jasmine there is no profit in the 1st year and profitable income is obtained from the 3rd year onwards to the seventh and annually about 6 400 *palams* of flowers are obtained which are sold at 6 pies per *palam*. After deducting the cost of cultivation, there is a net profit of Rs. 195 per acre for about five years. The flowers are easily marketed in Tinnevelly town.

It will be seen from the above that there is plenty of money in growing flowers provided ryots take advantage of growing them in suitable places round about towns. In big towns there is always a demand for them and marketing facilities are available.

Crop & Trade Reports.

Groundnut—1935—Fourth or Final Report. The average of the areas under groundnut in the Madras Presidency during the five years ending 1933—34 has represented 48·2 per cent of the total area under groundnut in India. The area sown with groundnut in the Presidency in 1935 is estimated at 2,492,500 acres. When compared with the corresponding estimate of 2,323,300 acres for the previous year and the actual area of 2,350,934 acres according to the season and crop report of the previous year, the present estimate reveals an increase of 7·3 and 6 per cent respectively. The estimated area for this year is less than the normal area of 3,317,650 acres by about 25 per cent. The increase in area is general outside Ganjam, Vizagapatam, East Godavari, Bellary, Anantapur, Coimbatore, the South (Tanjore excepted) and Malabar. The increase is marked in the Central districts (Coimbatore excepted). The area in Bellary and Anantapur has fallen from 412,600 acres to 292,000 acres due mainly to an increase in the area under cotton and other dry crops. The harvesting of the summer and early crop of groundnut was finished by October. The harvesting of the winter or main crop is proceeding. The crop is expected to be below normal in Vizagapatam, Guntur, Cuddapah, South Arcot, the Central districts, Tanjore, Tinnevelly and Malabar. The seasonal factor for the Presidency works out to 92 per cent of the average as against 78 per cent in the previous year according to the season and crop report. On this basis, the yield is expected to be 1,143,400 tons of unshelled nuts as against 920,260 tons in the previous year, an increase of about 24 per cent. The yield in an average year is estimated at 1,660,990 tons.

The wholesale price of groundnut shelled per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 5—14—0 in Tinnevelly, Rs. 5—13—0 in Cuddalore, Rs. 5—8—0 in Vizagapatam Rs. 5—5—0 in Berhampore, Rs. 5—4—0 in Negapatam, Rs. 5—2—0 in Guntur, Rs. 5

in Vizianagram and Cocanada, Rs. 4—15 –0 in Nandyal and Cuddapah, Rs. 4—12—0 in Adoni, Vellore and Salem, Rs. 4—11—0 in Coimbatore, Rs. 4—8—0 in Madura and Rs. 3—12—0 in Ellore. When compared with the prices for October 1935, these prices reveal a rise of 21 per cent in Cuddalore, 11 per cent in Ellore, 5 per cent in Vizagapatam, Guntur and Nandyal and 4 per cent in Cuddaph and a fall of 14 per cent in Coimbatore, 7 per cent in Berhampore, 6 per cent in Vellore, 5 per cent in Vizianagaram, 4 per cent in Madura and 3 per cent in Adoni and Salem. The price remained stationary in Tinnevelly.

Paddy—Final Forecast Report. 1935—36. The average of the areas under paddy in the Madras Presidency during the five years ending 1933—34 has represented 13·5 per cent of the total area under paddy in India. The area sown with paddy in 1935—36 is estimated at 11,000,000 acres as against 10,828000 acres for the corresponding period of last year and the finally recorded area of 11,055,587 acres in 1934—35. The present estimate falls short of the final area by 0·5 per cent and the area of 11,381 660 acres in an average year by about 3·4 per cent. 1,403,000 acres have been reported as sown since the last December forecast was issued. The extent so sown was large in Ganjam (125,000 acres), East Godavari, Chingleput (118,000 acres). South Arcot, North Arcot, Madura (103,000 acres), and Ramnad (152,000 acres). The area sown in December and January was greater than that sown in the corresponding period of last year by 286,000 acres or by about 26 per cent. The area under second crop paddy is expected to be generally below normal. The harvest of paddy is in progress. The yield is expected to be normal in Kistna, Guntur, Kurnool, Bellary, Cuddapah, North Arcot, Madura, and the Nilgiris, slightly above normal in South Kanara and below normal in the other districts. The yield was the lowest in Ganjam (84 per cent). The seasonal factor for the Presidency works out to 94 per cent of the average as against 96 per cent in the season and crop report of last year. On this basis, the yield works out to 98,090,000 cwt. of cleaned rice. This represents a decrease of about 1·6 per cent when compared with the estimate of 99,622,000 cwt. in the season and crop report of last year. The yield in an average year is estimated at 107,776,000 cwt.

The wholesale price of paddy per imperial maund of 82-2/7 lb. as reported from important markets towards the close of January 1936 was Rs. 2—12—0 in Nellore and Erode, Rs. 2—10—0 in Vizianagram and Cuddapah, Rs. 2--9--0 in Nandyal, Rs. 2—8—0 in Berhampore, Rs. 2—6—0 in Madura and Tinnevelly, Rs. 1—11—0 in Kumbakonam and ranged from Rs. 1—15—0 to Rs. 2—4—0 in the other markets. When compared with the prices reported in the previous month, these prices are stationary in Berhampore, Vizagaptam, Erode and Tinnevelly and are lower by 27 per cent in Kumbakonam and Salem, 24 per cent in Trichinopoly, 18 per cent in Vellore, 15 per cent in Cuddapah, 14 per cent in Madura, 9 per cent in Cocanada, 8 per cent in Negapatam, 6 per cent in Guntur, and 2 to 4 per cent in the other markets.

Cotton—Fourth Report. 1935—'36. The average of the areas under cotton in the Madras Presidency during the five years ending 1933—34 has represented 9 per cent. of the total area under cotton in India. The area under cotton up to the 25th January 1936 is estimated at 2,604,800 acres. When compared with the area of 2,135,100 acres estimated for the corresponding period of last year, it reveals an increase of about 22 per cent. 400 500 acres have been reported as sown since the last December forecast was issued. This extent is made up of an increase of 151,000 acres under Cambodia, 136,600 acres under Tinnevellies, 55,000 acres under Northerns and Westerns, 47,500 acres under Salems, 11,000 acres under Cocanadas and a decrease of 600 acres under other varieties of cotton in Vizagapatam due to the revision of estimates. The area sown in December and January exceeds that sown in the corresponding period of the previous year by

48,900 acres or by about 14 per cent. An increase in area in the current year occurs in all districts outside Vizagapatam, East Godavari, Kistna, Nellore, Chittoor, Coimbatore, Trichinopoly, Tanjore, Madura and Ramnad. In the Deccan, the area rose from 875,500 acres to 1,224,000 acres owing to the favourable season and the favourable price for cotton. The area under irrigated cotton mainly Cambodia is estimated at 266,400 acres as against 252,300 acres for the corresponding period of last year, an increase of 5·6 per cent. Pickings of the *mungari* or the early sown cotton crop in the Deccan are over. The yield was normal. Yields below normal are reported from all the main cotton growing districts outside Kurnool and the South. The seasonal factor for the Presidency works out to 94 per cent. of the average as against 87 per cent. for the corresponding period of last year. On this basis, the yield works out to 545,400 bales of 400 lb. lint as against 445,600 bales for the corresponding period of last year. It is, however, too early to estimate the yield with accuracy as the harvest has not yet commenced in the major portion of the area and much will depend upon the future weather conditions and the toll taken by insect pests.

The estimated area and yield under the several varieties are given below:–

(Area in hundreds of acres, i. e., 00 being omitted, yield in hundreds of bales of 400 lb. lint, i. e.. 00 being omitted.)

Variety.	Area from 1st April to 25th January.		Corresponding yield.	
	1935-36. Acs.	1934–35. Acs.	1935–36. Bales.	1934–35. Bales.
(1)	(2)	(3)	(4)	(5)
Irrigated Cambodia	252,8	241,0	153.1	137.6
Dry Cambodia	311,5	243,2	66,8	48,7
Total, Cambodia ...	564,3	484,2	219,9	186,3
Karunganni in Coimbatore ...	136,6	122,3	29,7	25,0
Uppam in the Central districts ...	33,6	36,4	5,3	5,5
Nadam and Bourbon	3,3	22,7	2	1,0
Total, Salems ...	173.5	181,4	35,2	31,5
Tinnevellies *	480,6	465,3	123,8	107,4
Northerns and Westerns ...	1,224,0	846.0	138.9	86,8
Cocanadas	150,9	146,2	26 3	32,1
Others	11,5	12,0	1,3	1,5

* Includes Uppam, Karunganni and mixed country cotton in the South.

The wholesale price of cotton lint per imperial maund of 82–2/7 lb. as reported from important markets towards the close of January 1936 was Rs. 19–6–0 for Cocanadas, Rs. 24—14—0 for Northerns, Rs. 17—11—0 for early crop Westerns. Rs. 26—5—0 for Cambodia, Rs. 24—12—0 for Coimbatore-Karunganni, Rs. 21–13–0 for Tinnevellies and Rs. 20—9—0 for Nadam. When compared with the prices in the previous month, these prices reveal a fall of 5 per cent. in the case of Cocanadas, 15 per cent. in the case of Nadam and 6 to 9 per cent. in the case of Westerns, Cambodia, Coimbatore-Karunganni and Tinnevellies. The prices of Northerns was stationary.

Gingelly—1935—36—Third Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1933—34 has represented 12 per cent of the total area under gingelly in India. The area sown with gingelly up to the 25th December 1935 is estimated at 500,600 acres. When compared with the area of 462,600 acres estimated for the corresponding period of last year, it reveals an increase of 8·2 per cent. The increase in area is general outside Vizagapatam, East Godavari South Arcot, North Arcot, Salem and South

Kanara. The increase is marked in, Trichinopoly (+18,500 acres). There has been a marked decrease in Salem (– 16.700 acres). The main crop has been harvested except in the south where the harvest is in progress. The crop suffered from drought to some extent and the yield is reported to be below normal except in East Godavari, West Godavari, Kistna, the Deccan, Salem, Ramnad and South Kanara. The seasonal factor for the Presidency works out to 92 per cent of the average as against 84 per cent for the corresponding period of last year. On this basis, the yield is estimated at 61,700 tons as against 53,300 tons for the corresponding period of last year, an increase of about 16 per cent.

Sugarcane—Third or Final Report—1935. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1933—34 has represented 3·7 per cent of the total area under sugarcane in India. The area planted with sugarcane up to the 25th December 1935 is estimated at 131,120 acres. When compared with the area of 122,470 acres estimated for the corresponding period of last year, it reveals an increase of 7·1 per cent. The estimate of the previous year was less than the final area of 125,310 acres by about 2·3 per cent. The present estimate of area exceeds the second forecast by 5,730 acres. The excess occurs mainly in Ganjam, West Godavari, Guntur, Bellary, South Arcot North Arcot, Salem, Coimbatore, Trichinopoly and South Kanara. The increase in area in comparison with the final forecast of 1934 occurs in all districts outside Ganjam, Guntur, Anantapur, Salem, Coimbatore, Madura and Ramnad. The harvest has just commenced and normal yields are expected in all districts outside the Circars (Guntur excepted), Anantapur, Salem and Coimbatore where the yield is expected to be below normal. The seasonal factor for the Presidency is calculated at 97 per cent of the average as against 91 per cent in the previous year. On this basis, the yield is estimated at 360,410 tons of jaggery as against 320,940 tons estimated in January 1935, an increase of 12·3 per cent. The final estimate for 1934—35 was 351,100 tons.

The wholesale price of jaggery per imperial maund of 82-2/7 lb. as reported from important markets towards the close of December 1935 was Rs. 6—14—0 in Nandyal, Rs. 6—6—0 in Tuticorin, Rs. 5—15—0 in Kumbakonam, Rs. 5—12—0 in Calicut, Rs. 5—9—0 in Madura, Rs. 5—4—0 in Bezwada, Rs. 4—15—0 in Masulipatam, Guntur, Bellary and Cuddapah, Rs. 4—8—0 in Rajahmundry, Rs. 4—7—0 in Salem, Rs. 4—6—0 in Vellore, Rs. 4—4—0 in Cocanada and Ellore, Rs. 4—2—0 in Vizagapatam, Rs. 3—14—0 in Coimbatore. Rs. 3—13—0 in Trichinopoly and Rs. 3—1—0 in Tinnevelly. When compared with the prices of the previous month, these prices reveal a fall of 19 per cent in Ellore, 14 per cent in Vizagapatam, Masulipatam, Nandyal and Trichinopoly, 13 per cent in Coimbatore, 10 per cent in Guntur, 9 per cent in Bezwada, 8 per cent in Bellary, 5 per cent in Rajahmundry and 4 per cent in Cocanada and a rise of 4 per cent in Cuddapah and Tuticorin. The price remained stationary in Vellore, Salem, Tinnevelly, Kumbakonam and Madura.

Imperial Council of Agricultural Research, Annual Report for 1934-1935—A Review.

The activities of the Imperial Council of Agricultural Research have attracted attention from the Indian States and enquiries, it appears, have been received from some of the important States as to the terms of admission to the Imperial Council of Agricultural Research.

Finance. During the year under review the council received a supplementary grant of Rs. 5,00,000 in lieu of the Annual Research grant that has been suspended, a grant of Rs. 2,50,000 for sugar research work, a special grant of Rs. 33,000 to

enable the council to make good earthquake damage at the Sugarcane Research Station at Mushari, Bihar and Orissa, and a grant of Rs. 33,000 for marketing expenditure on provincial portion of the marketing scheme. The Government further agreed to grant a sum of Rs. 4,16,000 for the establishment of a Central Dairy Institute.

Tobacco. The council has recently made grants to the local Governments and States concerned for the provision of flue-curing barns in connection with a co-operative scheme of experiments, to be carried out in consultation with the Director of the Pusa Institute, the general object of which is to ascertain in what areas the cultivation of cigarette tobacco could be extended. A scheme for a Central Tobacco Sub-station at Guntur, Madras, has since been sanctioned by the Governing Body. The site for the station has already been selected and it is expected to commence work in 1936–37.

Animal Health and Husbandry. During the year under review the Council continued its endeavours to stimulate research in the various branches of animal husbandry. The action taken by the Council to promote measures for the prevention and control of animal diseases by means of suitable All-India legislation was carried a stage further during the year. The draft bill and model rules which had been under the consideration of the Government of India were circulated to local Governments and minor administrations for their views. The following two schemes of animal diseases were sanctioned during the year, namely Investigations into vaccination of cattle against rinderpest in the Central Province, and Investigations of Johne's disease among cattle in Mysore. Under Animal Nutrition and Animal Industry, two schemes of Madras, one for animal nutrition and the other for sheep breeding were sanctioned.

Medicinal Plants. Under this head the scheme from Bengal for Research in the systematic cultivation of medicinal plants and study of food poisons, and a scheme from Mysore for the investigation of the Indian fish poisons and other Indian forest products for their insecticidal properties were financed during the year.

Progress Reports. The report then deals with the discussion of the Council on the progress reports of the various schemes financed by the Imperial Council of Agricultural Research such as rice research, rice physiology, potato breeding, investigations on cereal rusts, fruit research, dry farming, research into properties of colloid soil constituents, preparation of cheap synthetic manure from town refuse and waste materials, etc. In connection with the cold storage scheme of Bombay under fruit research, the report states that in view of the very limited cold storage facilities available at present between Bombay and London and of the difficulties at getting precise information as to the temperature and humidity conditions under which the fruit travelled, it has been decided to suspend experimental shipments, at least until the Poona experiments had yielded accurate technical data regarding the optimum conditions of storage and transport.

Sugar. The special sugar committee which met in July 1935 noted with appreciation the progress made in sugar research but considered that more intensive work was required in several directions, more especially in those connected with the improvement of the quality of the raw material, the raising of the standard of sugarcane cultivation, the combating of diseases and pests, the dissemination of information concerning improved methods, adequate demonstration and the more rapid multiplication and introduction of new seedling canes of proved value and their supply to cultivators. The Government of India made a grant of Rs. 2½ lakhs for financing existing schemes of sugar research during 1935–36.

The expansion of the sugar industry in India consequent on the grant of protection in 1932 has continued at a rapid pace. The United Province had the

largest number of the new factories. No less than 27 new factories began operations in the United Provinces in 1933-34, 14 in Bihar and Orissa, 5 in the Punjab, 2 each in Bengal and Madras, 4 in Bombay and 1 in an Indian State. The total number of cane factories reported to have worked during 1934-35 is 138. The statistical section of the Sugar Bureau collected and distributed statistics relating to the production, consumption, imports and exports of sugar for India and the principal sugar-producing and consuming countries of the world. During the year, 23 students were admitted for training in Sugar Technology at the Harcourt Butler Institute, Cawnpore, on the nomination of the Imperial Council of Agricultural Research. Of these 4 came from Bihar, 4 from Madras, 3 from the Punjab, 3 from Bengal, 2 from the Central Provinces, 2 from Bombay, 2 from the United Provinces and 1 each from Assam, Delhi and an Indian State.

Statistical Section. The statistician's help has been greatly sought after by the different provinces and constituent States in the planning of new experiments and in the interpretation of the experimental data. It might be stated that this section has considerably helped in generally raising the standard of agricultural experiments conducted all over India.

Locust. The locust survey work was continued on much the same lines as in previous years, the staff being distributed in three different circles each under the control of an assistant. In all the areas the desert locust still persisted in small numbers in the solitary phase. The staff visited all important localities in each circle periodically, so as to note the effect of seasonal conditions, on the habits and activities of the locust and on the fluctuation in its numbers. A substantial amount of information has been gathered in regard to breeding habits of locusts of the non-gregarious type and their general response to changes in the seasonal condition, but the data collected are insufficient to permit of definite conclusions. The delimitation of the areas important in regard to locust breeding has been made, and intensive survey work has been carried out in typical localities in such areas.

Marketing. The work in this section started with the appointment of an Agricultural Marketing Adviser in January 1935. He has a number of marketing and assistant marketing officers to help him and all the provincial governments and minor administrations and Indian States are actively co-operating by appointing their own separate marketing staff. The work consisted mainly of initiating a detailed survey of all crop and animal husbandry products.

Standing Committees for Rice and Wheat. The recommendations of the Crop Planning Conference with regard to the formation of standing committees for rice and wheat have been accepted. The functions of these committees would be to include the consideration of all matters relating to the production, marketing and general improvement of these two staple crops, periodical reviews of the statistical position of production and consumption (internal and external) of rice and wheat and progress in research in connection with these two cereals. These committees have just been formed and include representations from Government of India, Local Governments, Constituent Indian States, the Inter University Board, the Associated Chambers of Commerce and Industry.

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The Rice Committee of 45 members includes the following 7 representatives from Madras.

(1) The Director of Agriculture, (2) The Paddy Specialist, (3) The Zamindar of Devarakotta (Chellapallli) President, District Board, Kistna, Masulipatam (Rice Grower), (4) Prof. P. J. Thomas of Madras University, (5) Mr. N. Rangasamy Reddiar, Kuttalam, Tanjore District (Rice Merchant), (6) Mr. A. Pamidiah, Bezwada (Rice Miller) and (7) Mr. K. P. V. S. Mahammad Meera Rowther Sahib Bahadur, M. L. C. Negapatam (Trade Representative).

The Imperial Council of Agricultural Research— Advisory Board Meeting.

The half yearly meeting of the Advisory Board was held in Delhi from 10th to 15th of February, Sir Bryce Burt, Vice Chairman, presiding. Sir Jagdish Prasad, Hon. member for Health, Education and Lands presided over the opening sessions on the 10th and welcomed the members. He paid a tribute to Sir T. Vijayaragavachariar who was the Vice Chairman of the Council ever since its inception. He mentioned it as a pleasing feature that while the Board in its early stages was concerned with a number of applications for grants, at present it was dealing with a number of progress reports in regard to schemes financed by the council to see that the schemes are being worked on proper lines. The important feature of the Board meeting was, he stated, that scientific workers were no longer working in water tight compartments. He referred also to the co-operation of Universities in carrying out important investigations.

The various sub-committees, dealing with rice, soil science, fruit, plant diseases, dry farming, insects, animal husbandry, animal breeding, etc., met at later dates to examine progress reports of schemes already working and to examine new schemes put up to the council for financial help. One of the subjects considered at the Board Meeting was the question of the future research programme of the council and arranging for a special review of the present position of agricultural and veterinary research. One of the new schemes from Madras that came up for discussion at this Board Meeting was about research on coconuts and, we understand, it was passed by the Board with certain modifications.

There are a large number of schemes from the different provinces already approved by the Advisory Board and awaiting sanction of funds to start work on them. We are glad that the Government of India in this year's budget has provided for a grant of 30 lakhs towards agricultural research, and we expect this will enable the Imperial Council of Agricultural Research to provide funds for a large number of schemes that could not be started earlier for want of funds.

College News & Notes.

Students' corner. *Literary.* The valedictory address of the literary section of the Students' Club was delivered by Mr. N. G. Charley, Research Engineer on 13th March. "My tour to Kashmir" was the subject of the discourse. In the lengthy discourse lasting for nearly 2 hours, Mr. Charley touched on the various aspects of Kashmir and Kashmiri life and illustrated his remarks by a number of lantern slides.

Sports. There were a hockey match and a cricket match between the officers and the students. The former ended in a victory for the students and the latter for the officers.

Club Day. The Annual Day of the Agricultural College Students' Club was celebrated with great enthusiasm on the evening of February 22nd. Mr. S. R. U. Savoor, M. A. (Cantab), D. Sc. (Lon.), Bar-at-law, I. E. S., Principal, Victoria College, Palghat was the president on the occasion. The function started with a well arranged tea for guests and members of the club numbering in all over two hundred. While at tea the guests were entertained to a fancy dress competition. The tea was followed by the formal distribution of prizes for winners in various

competitions, literary and athletic. The variety entertainment got up by the students for the occasion was much appreciated by all. The function came to a successful termination after a short speech by the distinguished president. The following were the prize winners: *Essay competition.* 1st S. S. Sarma. 2nd K. Jayaram and J. Raghothama reddy. *Extempore elocution competition.* 1st J. Raghothama Reddy. 2nd H. Krishna Kumar. 3rd S. Krishnananda Sastry. *Colours for proficiency in games. Cricket.* Messrs. C. N. Babu, D. V. Rajagopalan and K. Dinker Rao. *Hockey.* Messrs. Joseph Dass, D. V. Rajagopalan and C. Sampath. *Football.* Mr. M. S. Kolandaiswami. *Parlakimidi cup* for all round proficiency in games and Athletics Mr. Moncey Joseph. *The victory (inter-class) cup.* 1st year. *The Parnell (inter-class hockey) cup.* 1st year. *The Rao Bahadur C. Tadulingam (inter-tutorial) cricket cup.* Mr. K. Ramiah's wards. *The R. Krishnamurthi Rao (inter-tutorial) hockey cup.* Mr. C. Narasimha Iyangar's wards. *The Rao Sahib V. Muthuswami Iyer (inter-tutorial) football cup.* Rao Bahadur S. Sundararama Iyer's wards. The handicap tennis doubles tournament:— *Winners.* Moncey Joseph and Abdul Ghaffoor. *Runners up.* P. M. Sayeed and Herbert Adiseshiah. *The Cecil Wood tennis cup.* (Singles). *Winner.* Moncey Joseph, runner up S. D. S. Albuquerque. *Badminton Doubles. Winners.* Messrs Herbert Adiseshiah and P. M. Sayeed. *Runners up.* Messrs. Subrahmaniam and D. Ramarao. *Badminton fives. Winners.* Mr. Moncey Joseph's team. *Tennikoit doubles. Winners.* Messrs. H. Ramanadha Rao and K. Jayaram. *Runners up.* Messrs. Moncey Joseph and Murugesan. *Basket ball fives. Winners.* Mr. P. Ramanatha Rao's team. *Volley ball sixes. Winners.* Mr. K I. Tobias, team. *Inter-class relay race.* First year. *Intermess tug of war.* West coast mess. *Ping pong. Winner.* Mr. A. V. Parthasarathy. *Runner up.* Mr. S. L. Narayana. *Carrom, Singles. Winner.* Mr. A. V. Parthasarathy. *Runner up.* Mr. Lakshmana Rao. *Doubles. Winners.* Messrs. A. V. Parthasarathy and S. S. Sarma. *Runners up.* Messrs. Somasundaram and J. Suneetha. *Chess. Winner.* Mr. Moncey Joseph. *Runner up.* Mr. J. Subrahmaniam. *Draughts. Winner.* Mr. Ramanujam. *Runner up.* Mr. K. Rajabaniah. *Blow ball. Winner.* Mr. R. H. Krishna's team. *Fancy dress.* 1st Mr. Kannyan. 2nd Mr. Chellappa. 3rd Mr. R. Ali Hyder. *Consolation Prizes.* Messrs. Shanmuganaianar, Gitachari and Ittyachan.

College Day and Conference. As already announced, the College day and conference will come off in July, and it is expected that His Excellency the Governor of Madras will preside. Persons desirous of reading papers at the conference are requested to communicate with the Secretary, M. A. S. U.

Ramasastrulu Munagala Prize. Elsewhere in this issue, appears an announcement regarding this prize. The attention of the members of the Union is invited to it.

The soil survey work in connexion with the Tungabhadra scheme has been completed and we understand that the officer has forwarded his report to Government. Consequent on the winding up of this work the appointments of 10 upper subordinates have been terminated.

Mr. Varahalu, Assistant in Chemistry has been awarded the M. Sc. degree of the Madras University for his thesis on the Chemistry of Jaggery Making.

Rao Bahadur M. R. Ramaswami Sivan, has been returned to the Senate by the Registered Graduates constituency.

The headquarters of the Soil Physicist to the Govt. of Madras has been transferred to Hagari from Coimbatore. Dr. Subba Rao and his assistants left Coimbatore on 29th inst.

Visitors. Mr. P. V. Isacc, Entomologist, Imperial Research Institute of Pusa is on a visit to Coimbatore, in connexion with the study of sugarcane insects.

Mr. F. H. BUTCHER

Mr. F. H. Butcher, Retired Curator of the Government Botanical Gardens, Ootacamund was born at Maresfield in Sussex on the 29th May 1881. He entered the Royal Botanic Gardens, Kew in 1905 after being trained at noted Gardens and Nurseries, including Longleat, the country seat of the Marquis of Bath. Whilst at Kew he obtained certificates for Systematic Botany, Geographical Botany and Physics and Chemistry and was also awarded a certificate for a collection of British plants.

In May 1907, Mr. Butcher was appointed by the Secretary of State for service in India and arrived at the Royal Botanic Gardens at Sibpur, Calcutta on 17th July of the same year, and after training was appointed Assistant Curator of the Garden. Subsequently he also acted as Curator for a short time. From Sibpur, he came over to Ootacamund as acting Curator of the Botanic Gardens and Parks in November 1908, and later was confirmed as Curator in 1910 and held the post until retirement.

During the period spent at Sibpur, he was deputed by the Botanic Survey of India with W. G. Craib, afterwards Professor of Botany at Aberdeen University to tour the Khasia Hills on a plant collecting expedition during which a large collection of herbarium specimens and living plants were made, one or two of which were I believe, new to science. At the Sibpur Botanic Garden he worked successively under Col. Gage, I. M. S., the then Superintendent and Sir William Wright Smith, the then Curator of the herbarium who for a time acted as Superintendent and is now Regius Keeper of the Royal Botanic Garden, Edinburgh and world famed botanist. It was mainly through Sir William's influence that Mr. Butcher was appointed to the Botanic Gardens, Ootacamund.

During his regime as Curator many new trees and plants have been introduced to the Nilgiris; the Agricultural Research Station at Nanjanad was established by him in 1917 and until a few years ago remained in his charge excepting for brief periods. The Pomological Station at Coonoor was also started by him in 1920 and still remains in his charge, the more important fruits successfully introduced and cultivated at this Station being the Japanese Plum, the Grape-fruit, Persimmon and one or two varieties of Apple. The Kallar and Burliar Fruit Stations are also in his charge and at these Stations the culture of the Mangosteen has received special attention and a large number of young trees of these have been established and are coming into bearing.

Mr. Butcher has been the Secretary of the Nilgiri Agri-Horticultural Society for over 27 years and was present at the Society's Annual Exhibitions every year with one exception.

He joined the Nilgiri Volunteer Rifles (now designated as the Nilgiri Malabar Battalion) in 1912, received his first Commission in 1915, rose to the Second in Command of the Battalion and retired with the rank of Major in 1934. He was the recipient of the General Service Medal for services rendered during the Great War, the Indian General Service Medal (Malabar) and the Volunteer long service Medal. Mr. Butcher is also a prominent Freemason and was for many years a keen *Shikari*. We wish him in his retirement, all health and happiness. (*R. C. B.*)

Weather Review (FEBRUARY 1936).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	3·2	+2·5	4·8	South	Negapatam	4·2	+3·6	4·2
	Berhampore *	3·4	+2·5	5·1		Aduthurai *	2·0	+1·8	2·0
	Calingapatam	2·8	+2·4	2·9		Madura	2·5	+2·4	2·7
	Vizagapatam	3·7	+2·9	4·7		Pamban	1·3	+0·7	1·7
	Anakapalli *	4·6	+1·8	0·0		Koilpatti *	1·2	+0·5	1·3
	Samalkota *	7·2	+6·2	7·5		Palamkottah	1·4	+0·6	1·60
	Maruteru *	4·1	+3·9	4·1					
	Cocanada	3·4	+3·1	4·6					
	Masulipatam	4·4	+3·9	4·4	West Coast	Trivandrum	0·0	−0·7	0·4
						Cochin	1·5	+0·7	1·4
Ceded Dists.	Kurnool	1·7	+1·6	1·7		Calicut	3·3	+3·1	3·3
	Nandyal *	1·1	+0·9	1·1		Pattambi *	0·7	+0·1	0·7
	Hagari *	0·90	+0·5	0·9		Taliparamba *			
	Bellary	0·0	−0·2	0·0		Kasargode *	0·2	−0·1	0·18
	Anantapur					Nileshwar *	0·3	+0·1	0·3
	Cuddapah	0·5	+0·4	0·5		Mangalore	0·8	+0·8	0·8
Carnatic	Nellore	1·9	+1·8	1·9					
	Madras	2·5	+2·2	2·6	Mysore and Coorg	Chitaldrug	0·1	+0·1	0·1
	Palur *	2·4	+2·2	2·4		Bangalore	0·0	−0·1	0·0
	Palakuppam *	1·5	+0·67	1·53		Mysore	0·2	0·0	0·2
	Cuddalore	2·0	+1·1	2·0		Mercara	0·3	0·0	0·3
Central	Vellore	0·7	+0·3	0·7					
	Hosur cattle farm *				Hills.	Kodaikanal	0·6	−0·8	0·8
						Coonoor	2·7	—	4·2
	Salem	3·5	+3·3	3·5		Ootacamund *	0·8	+0·1	5·9
	Coimbatore	1·4	+1·0	1·4		Nanjanad *	0·8	+0·3	1·0
	Coimbatore Res. Inst. *	1·2	+0·8	1·2					
	Trichinopoly	0·6	+0·1	0·9					

* Meteorological Stations of the Madras Agricultural Department.

Summary of Weather Conditions. During the month a number of Western disturbances affected the North West Frontier. These disturbances caused thunderstorms and local rains in Kashmir, Baluchistan and North West Frontier. Thunderstorms gave nearly general rain in the West Central Provinces and local rain in the North Hyderabad, North Madras coast, Mysore and Malabar. Light

scattered rains were general in the South East Madras during the first week of February. Later there occasioned general rainfall in the South East of Madras.

Skies were moderately to heavily clouded during 2nd and 3rd week and lightly to moderately clouded in the 1st and last week of this month in the Peninsula.

Humidity was generally in excess in the Madras Presidency. The minimum temperatures in general, were above normal in the Peninsula.

Rainfall was in large excess in the Circars and in moderate excess in the Central and Southern districts and in Deccan and nearly normal elsewhere.

Weather Report for Research Institute Observatory:

Report 2/36.

Absolute Maximum in shade	93·5°F.
Absolute Minimum in shade	57·5°F.
Mean Maximum in shade	91·0°F.
Departure from normal	+ 0·4°F.
Mean Minimum in shade	67·9°F.
Departure from normal	+ 2·4
Total Rainfall	1·21"
Departure from normal	+ 0·81
Heaviest fall in 24 hours	1·14" recorded on 10th.
Total number of rainy days	1
Mean daily wind velocity	2·2 M. P. H.
Mean Humidity at 8 hours	75·4%
Departure from normal	+ 3·9

Summary. The maximum and minimum temperatures were above normal during this month. Humidity was in excess of the normal by 3·9%. A rainfall of 1·14" was recorded on 10th. The skies were moderately to heavily clouded during this month P. V. R. & D. V. K.

Departmental Notifications.

Gazette Notifications. 1. Mr. Butcher permitted to retire from 26-2—'36. 2. Mr. P. Abishekanathan Pillay appointed as curator, Govt. Botanic Gardens, Vice 1. 3. Mr. C. Ramaswami, A. D. A., Cuddalore, l. a. p. for eight months, outside India. Mr. S. Narayaniah to officiate as A. D. A., Vice 3, posted to Tinnevelly. 4. Mr. R. N. K. Sundaram, A. D. A., Tinnevelly to be A. D. A., Cuddalore.

Subordinate Service. *Promotions.* Mr. V. Ratnaji Rao, Agricultural section from III grade to II grade (Rs. 225), with effect from 26—2—'36. Mr. C. S. Gopalaswami Rao, Mycology section—IV grade to III grade (Rs 200) from 26—2—'36.

Transfer. Consequent on the winding up of soil survey work in the Tungabadra project, Messrs. G. K. Chidambaram and C. Raghavendrachar to revert to their posts as Assistants in Chemistry under the G.A.C. Mr. K. Raghunatha Reddy to Agricultural Section, IV circle. Mr. K. Tejappa Shetty to Agricultural Section, III circle. Mr. M. Subba Reddy to Agricultural Section, Fruit Station, Kodur. Mr. M. Rama Reddy to Agricultural Section, II circle. Mr. V. V. Jaganatha Rao, Agricultural Section, I circle. Mr. M. Sitharama Raju, Agricultural Section, A. R. S., Anakapalle. Mr. W. Tirumal Rao to be offg. Assistant in Chemistry. Mr. A. B. Adiseha Reddy to be officiating Assistant in Chemistry. Mr. Bennet P. Masilamony to Agricultural Section, III circle. Mr. K. Venkataswami to Agricultural Section, IV circle.

Mr. M. C. Menon, F. M., Live Stock, R. S. Hosur to be F.M.A.R.S., Taliparamba, Mr. K. Krishnan, F.M.A.R.S., Taliparamba to Live Stock Section, Hosur.

Leave. Mr. V. Kumaraswami, A. D., Madanapalle, l. a. p. for 3 months from 15—4—'36. R. N. Muthuswami, A. D. Tiruppur (CO_2 Scheme) leave for two months from 19—2—'36. Mr. K. Veerabadra Rao, Assistant in Chemistry leave for 2 months and 17 days from 26—2—'36.

Termination of Appointments. Upper Subordinates, Messrs. P. C. Sahadevan, V. V. Rajagopalan, K. Minakshisundaram, K. M. Narayanan, B. G. Narayana Menon. K. Venkatadri Reddy, M. Srinivasa Rao, K Krishnamurthi, C. Vadamalai with effect from 1—1—'36

The Ramasastrulu—Munagala Prize, 1936.

1. The prize will be awarded in July 1936.

2. The prize will be in the form of a Medal and will be awarded to the member of the Union who submits the best account of original research or enquiry, carried out by him on any agricultural subject.

3. The subject matter shall not exceed in length twelve foolscap pages, type-written on one side.

4. Intending competitors should notify the President or Vice-President of the Madras Agricultural Students' Union not later than the 15th May the subject of the paper which they propose to submit, and the paper should be sent in so as to reach the President or Vice-President, Madras Agricultural Students' Union not later than the 1st June 1936, with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper, but should be entered under a nom-de-plume.

5. Four type-written copies of the essay should be sent in.

6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference.

7. Papers submitted will become the property of the Union, and the Union reserves to itself the right of publishing all or any of the papers.

8. All references in the paper to published books, reports or papers by other workers must be acknowledged.

9. Any further particulars may be obtained from the President or Vice-President, Madras Agricultural Students' Union, Lawley Road, P. O., Coimbatore.

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JULY 1936

Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

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Editorial.

Welcome to H. E. Lord Linlithgow, the Viceroy. On behalf of the Madras Agricultural Students' Union, we offer our hearty welcome to H. E. Lord Linlithgow who has taken over the reins of Government in India this month. As Chairman of the Royal Commission on Agriculture he has acquired a very clear picture of the agricultural conditions and problems in every province. That he will take an abiding interest in the rural uplift is amply evident from his recent utterances in England prior to his leaving for India. His monumental industry, his tireless attention to details, and the thoroughness and quickness of grasp with which he tackles problems, are all familiar to those who have watched him during his Chairmanship of the Royal Commission in India. We are sure that during his regime as Viceroy of India there will be a great stimulus given not only to the development of Agriculture, the primary industry of this vast continent, but also to several well thought out measures intended to ameliorate the condition of the vast masses who depend on land for their bare existence.

Agricultural Associations. Among the agencies thought of, to supplement the propaganda work of the Agricultural Department, the Agricultural Associations might be considered quite important. There is no doubt that such associations could be utilised to disseminate knowledge of agricultural improvement. In our own province, even 30 years ago, there were in existence several District Agricultural Associations with a Central Committee in Madras. Although in the flush of enthusiasm, some useful work was done by these

associations in the beginning, the enthusiasm soon waned and it was found difficult to get the Associations to undertake any practical demonstration of agricultural improvements advocated by the Department. The movement was probably premature and the Central Agricultural Committee had to be wound up, the district associations soon following suit. Among the causes for such failure might be mentioned :— (1) the associations consisted generally of men who did not have a direct interest on land, (2) the associations tried to cover too big an area to permit of the concentration of a particular activity in a definite area, (3) the associations were brought into existence by the enthusiasm displayed by one or two particular individuals rather than by a general desire on the part of the people in the villages (4) Due to the paucity of trained staff in the Agricultural Department the associations could not get much of the technical help necessary. The last difficulty has to a certain extent been overcome by the expansion of the Agricultural Department in recent years, there being roughly one Agricultural Demonstrator for each revenue taluq of a district. The only means of overcoming the other difficulties would be to make the association really rural, the actual cultivators making up its strength. We are glad the Director of Agriculture, Madras, in his opening speech at the Nellore District Agricultural Association rightly pointed out the need for starting the associations first in villages, which alone would result in real work connected with rural uplift being done. The experience gained in other Provinces also points out definitely that the smaller the area for which the association is intended the greater are the possibilities of its doing really useful work. If we should benefit from our early experiences it is necessary that we should begin first at the bottom by forming village or *firka* associations and later co-ordinating their work by linking them up with taluq or district associations.

With the increasing interest paid to Agriculture in recent times, the question of forming agricultural associations has again come up for consideration in several parts of the province. Among the several Government Departments, the Revenue Department naturally weilds considerable amount of influence and regard among the land-owning classes and there is no doubt, that any association with the revenue officials actively co-operating in its work, is bound to be more productive of results. Sir Charles Souter, the Revenue Member to the Government of Madras when he presided over the Agricultural Conference in Coimbatore last August drew pointed attention to the necessity of the officers of the various Departments interested in rural welfare, actively co-operating and seeking the advice and help of the Revenue Officials. We are glad to note that a beginning has been made in some districts to carry into effect the suggestions of the Revenue Member. The Deputy Director of Agriculture Second Circle, had approached the District Collectors in his Circle to form

Agricultural Associations one in each revenue *firka* of the district. His suggestion to make the revenue inspector of each *firka*, the President of such association, has been accepted by the District Collectors and the Board of Revenue and a number of associations have been recently brought into existence in Guntur District. The members of these associations are all influential and bonafide ryots actually interested in the improvement of agriculture. The example set up by Guntur is, we understand, being followed by other districts in the Second Circle, Kistna and Nellore.

The main objects of these associations are stated to be:—(1) to introduce better methods of cultivation, (2) to introduce heavy yielding strains of crops recommended by the Agricultural Department and also to actually test new strains of crops in the locality to supplement the results obtained at the Government Research Stations, and (3) to arrange, if possible, for the proper marketing of the produce of the ryots. The associations will get the technical help of the Demonstrators, and the Demonstrator usually having the jurisdiction of a whole taluq will have a number of trained demonstration *maistries* under him, probably one for each firka. The programme of work for the associations will, we expect, be drawn up by the officers of the Agricultural Department who are familiar with the local conditions. If only the members of these associations take a living interest in the work and undertake to carry out the improvements suggested by the Department, we are sure some tangible results can be achieved. Probably, after some time these associations could be utilised to bring about improvements in the village in other spheres as well, as for example, rural sanitation, public health, education, etc., the members of the concerned Government Departments working through these associations. In course of time there should be a large number of groups of villages trying their best to help themselves in all rural welfare work. We wish all success to the new venture undertaken in the second circle which we hope will be copied and extended to all the districts in the Presidency.

It was a surprise to see that a member of the local legislative council during the recent budget session criticised the work of the Agricultural Department by stating that the Department had done 'next to nothing'. While several of his sweeping statements can be readily refuted by actual facts, he was inclined to blame the Agricultural Department for all the difficulties which the cultivator is labouring under in these days of general depression. We are gratified, however, that another member of the council while commending the work of the Department stressed upon the necessity for the co-operation of the non-officials in the propaganda work. We are glad he particularly mentioned about the work of these newly formed agricultural associations and recommended the extention of such activities in other districts.

INHERITANCE OF GLUME LENGTH IN *RAGI*, *ELEUSINE CORACANA* (Gaertn), THE FINGER MILLET

By G. N. RANGASWAMI AYYANGAR, B.A., I. A. S.,
Millets Specialist, Agricultural Research Institute
and
U. ACHYUTHA WARIAR, B. Sc. Ag.,
Assistant, Millets Breeding Station, Coimbatore.

The earhead of *Eleusine coracana* is a terminal whorl of digitate spikes radiating from the apex of a culm. Each of the spikes consists of two rows of sessile spikelets. The spikelets usually contain 5 to 10 glumes each, of which the two lower-most are barren and the rest are paleate, each enclosing a complete flower. When the grains set and develop, they peep out of the glume and present the seriate appearance characteristic of this earhead.

The average length of the glumes in the spikelet of a normal type of cultivated *ragi* in South India, is as follows from bottom to top.

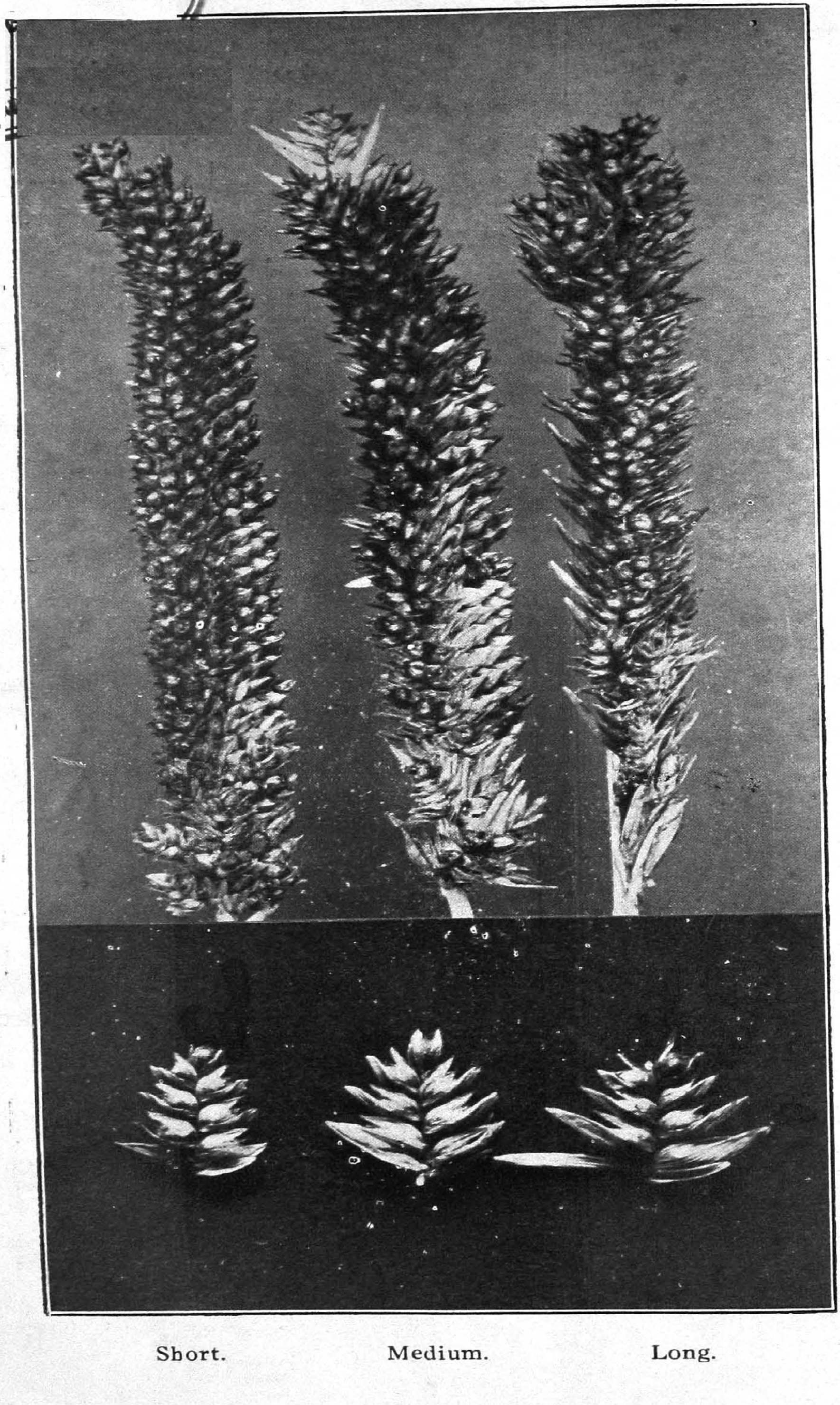
Table I.

		Average Length in mm.
Glume	I	4·0
,,	II	5·0
,,	III	4·5
,,	IV	4·5
,,	V	4·0
,,	VI	3·5
,,	VII	3·5
,,	VIII	3·0
,,	IX	3·0
,,	X	3·0

It will be noticed that the first is shorter than the second. The second is the longest glume. There is a gradual reduction in this length towards the top glumes. This trend in glume length may be said to be general in all the *Eleusines* including the wild ones, *E. indica* and *E. aegyptiaca*. In the wild *Eleusines* the grains are small and long, and are well enclosed by the glume and palea. In the cultivated *ragi* the grain is a bit longer than the wild ones and considerably thicker, so that the spherical grains push apart the glume and the palea, and get visible.

In M. S. 1567, an African variety of *ragi* from Nyassaland, a type was noticed where the glumes of the spikelet were longer than normal short ones. The spikelet, (due to the long glumes) presented a chaffy look and had an obovate appearance instead of the usual ovate of the common *ragi*. This type was suspected to be an abnormality, possibly pathological. But as the growth and appearance in subsequent years was the same, it was put down to be a varietal characteristic surviving in the original habitat of this "African Millet". The relative glume and palea lengths of this type and that of the local cultivated *ragi* are given below:—

GLUME LENGTHS IN RAGI,
(*ELEUSINE CORACANA*, GAERTN).



Short. Medium. Long.

Table II. *Length of Glumes and Palea.*

		Local—Short Glume.		African—Long Glume.	
		Glume.	Palea.	Glume.	Palea.
		mm.	mm.	mm.	mm.
Glume	I	4·0	—	4·0	—
„	II	5·0	—	8·0	—
„	III	4·5	4·0	8·5	4·0
„	IV	4·5	3·5	7·0	4·0
„	V	4·0	3·0	6·0	4·0
„	VI	3·5	3·0	5·0	4·0
„	VII	3·5	3·0	4·5	4·0
„	VIII	3·0	3·0	4·0	3·5
„	IX	3·0	3·0	3·5	3·5
„	X	3·0	2·5	3·0	3·0

It will be noted that the variety from Nyassaland has glumes definitely longer than the normal. It is remarkable that this glume length notwithstanding, the length of the palea remained the same in both the Indian and African varieties. The same equality in size was noticed in the grain also. It will thus be seen that the difference lay in the length of the glumes only. It is the large glume of the African variety that partially hides the grain and gives the earhead its chaffy look.

The inheritance of this "Glume Length" character was pursued. In crosses between normal and long glumes, the first generation plants had the normal Short glumes and in the second generation the following segregations of the glume lengths, Short, Medium and Long (see Fig.) were obtained.

Table III. *Inheritance of Glume Length.*

F_2 Family No.	Segregating for glume lengths. Short.	Medium.	Long.
E. C. 2953	152	122	34
„ 2958	142	155	53
„ 2961	131	124	40
„ 2962	124	128	42
„ 2963	116	125	42
Total	665	654	211

To interpret these ratios, 90 selections were carried forward from family E. C. 2958 to a third generation. The behaviour of these selections is given below:—

Table IV. *Family E. C. 2958—F_3.*

Character of Selections.	Number of Families.	Behaviour in F_3 Short.	Medium.	Long.	(x^2)	P value.
	1	203				
Short	2 (3 : 1)	105	42	—	·9	·3<P<·5
(14)	3 (9 : 6 : 1)	205	166	32	4·1	·1<P<·2
	8 (27 : 27 : 10)	276	255	98	·8	5<P<·7
	10		532			
Medium	27 (3 : 1)		1639	538	·1	·7<P<·8
(52)	15 (9 : 7)		446	321	1·2	·2<P<·3
Long (24)	24			1509		
Total	90					

The long glume is about twice the length of the short glume and juts prominently beyond the grain. The length of this glume and the comparatively hidden grains, gave the earhead a characteristic chaffy look, which afforded a dependable qualitative guide in the grouping of the segregates.

Table IV reveals that in Table III we had the rather rare 27:27:10 ratio whose P value is between ·1 and ·2. A study of Table IV shows that there are three factors determining glume length. These may be designated Gl_1, Gl_2 and Gl_3. All the three factors should be present to give a normal Short glume. Any two of them make a Medium glume. Each one of them or none produces a Long glume. The general fit of the figures in Table IV to the theoretically expected behaviour will be evident.

A Long glume connotes wild affinities and economic disabilities. In this closely pollinated millet there must have been Longs of many races and of different genetic constitutions. When these came together, they also brought together supplementary factors, whose joint effect was an inhibition in glume length. Any two of the three factors for glume length might bring about the first stage of the desired reduction. The Medium lengths being thus brought about, they needed only an additional factor to bring about the normal glume length with its visible grains. This additional factor could be available in many of the sister Mediums and some of the original Longs. There are thus afforded many opportunities at a supplementary endeavour, which neutralize in some measure the paucity of chances at cross pollination and subsequent selection. A shortening thus secured, selective forces must obviously have helped to perpetuate the normal Short glume with its visible grain. This triple play of factors offers, therefore, a decent chance for an elimination of the undesirable length in the glume. This phenomenon gives a glimpse of one of the many ways in which genetic factors play on each other, towards an evolutionary advance.

Summary. The *Short* length of the glume in a normal cultivated *ragi* is due to the presence of three dominant factors Gl_1, Gl_2 and Gl_3 functioning as inhibitors of glume length. Any two of the above three, increase the length of the glume and give a *Medium* length. Each of them singly, or none, gives a *Long* glume. The inter-play of these factors results in a 27 : 27 : 10 ratio of Short : Medium : Long glumes.

NOTE ON THE METHOD OF COMPUTING CROP FORECASTS

BY N. K. ADYANTHAYA,
Statistical Officer, Madras.

Forecasts reports of area and yield are framed for nine crops, viz., paddy, sugarcane, groundnut, gingelly, castor, cotton, pepper, ginger and senna. The estimates relate to all the districts in which the respective crops are grown.

Approximately two-thirds of the cultivated land in the Madras Presidency is Government or ryotwari land and has been carefully surveyed. All the village officers therein are appointed and controlled by Government officials. In the ordinary course of his work, the village accountant sends by the 25th of each month to the Revenue Inspector, i. e., the officer in charge of a group of villages varying in number, a detailed cultivation statement of the sowings of crops and the outturn of harvested crops in his village in terms of annas, under the separate heads, 4 to 7 annas, 8 to 11 annas, 12 annas and 13 to 16 annas (12 annas standing for a normal crop). The Revenue Inspector records in a separate forecast register which he maintains, the distribution of area and the expected anna yield for each crop in each village in the firka and strikes a total of the areas and an average of the anna outturns based on the village accountants' figures and his personal experience. In the month in which a forecast report is due, the Tahsildar compiles the figures of area under the crop sown to-date since the beginning of the forecast year and also the expected average anna yield figure from the firka registers submitted to him by the Revenue Inspectors. He then strikes a total of the areas sown in the several firkas and an average anna estimate of the outturn for the whole taluk, based on the figures reported by Revenue Inspectors and his personal experience. The return so prepared is sent to the Board of Revenue.

Nearly a third of the Presidency is whole inam and zamindari of which only a part has been accurately surveyed and for which somewhat similar returns are prepared. In every case, the Tahsildar or Deputy Tahsildar estimates the area and yield as well as he can from his own knowledge and from reports of the estate officials as the village accounts are not carefully maintained in the estate villages. The figures for whole inam and zamindari areas are included but shown separately in the reports sent by Tahsildars to the Board of Revenue.

The Indian States of Pudukkottai and Banganapalli send similar reports direct to the Board of Revenue for cotton only.

Thus some 240 reports for each of the forecast crops except senna, pepper and ginger are received in the Board's office. The

reports received are scrutinised in the first instance and the figures are then tabulated in the forecast registers.

It must however be understood that the figures of area reported for the forecasts are not complete owing partly to a certain percentage of village accountants and Revenue Inspectors failing to report in time and partly to the fact that *karnams* sometimes fail to book the entire area under cultivation up to a stated period. The reported area has therefore to be subjected to a correction in the Board's office. The correction applied is mainly to secure that the corrected area may represent as closely as possible the actual area sown in the period to which the forecast relates. The correction has in the first instance to take into account the liability to under-estimate or over-estimate the area by certain *Tahsildars* as revealed by a comparison of the areas reported in the final forecasts with those in the G-returns (*Jamabandi* return) over a series of years. It has also to take into account the liability to under-estimate or over-estimate the area on the part of *Tahsildars* contrary to what the state of the season as revealed in the weekly season reports by collectors and the reports of Deputy Directors of Agriculture would warrant.

The yield of a crop in a district is the product of three factors, namely (1) the area under the crop in acres, (2) the normal yield per acre and (3) the seasonal factor or the condition figure which expresses the relation in the form of a percentage of the actual crop to the normal crop.

(1) has already been dealt with. As for (2), the figures of the normal yield per acre for the several crops are given in Appendix VIII to the season and crop report. The normal yields for crops were fixed by the Director of Agriculture in 1919.

As regards the seasonal factor, the procedure adopted in the Board's office is as follows:—

The average anna figure of each crop in the district is first determined.

Let A acres be the total area under a crop made up of

a_1 acres under 0 to 3 annas.

a_2 acres under 4 to 7 annas.

a_3 acres under 8 to 11 annas.

a_4 acres under 12 annas.

a_5 acres under 13 to 16 annas.

so that $A = a_1 + a_2 + a_3 + a_4 + a_5$.

The average anna figure (reported) will then be

$$Y = \frac{(a_1 \times 1\frac{1}{2}) + (a_2 \times 5\frac{1}{2}) + (a_3 \times 9\frac{1}{2}) + (a_4 \times 12) + (a_5 \times 14\frac{1}{2})}{A} \text{ annas.}$$

The equivalent percentage figure will be

$$p = \frac{Y}{12} \times 100$$ as 12 annas is equivalent to normal (=100).

The village accountant's pessimism will now have to be allowed for. For the main crops whose yields are calculated and entered in the season and crop report, figures of p are available from 1902—3 or some later year. If the accountant were not a pessimist, his p's for any crop would be a series whose average over a number of years would equal or approximate to 100, for an average crop is the best approximation to a normal crop.

It has been found that the actual averages of p's for various crops and districts are however always less than 100, and in fact range from *70* to *90*.

The method of interpreting the accountant's report is as follows:-

Let 80 be the average of *p*'s for paddy in a district. If 75 is the *p* for the year in question, the corrected percentage (condition factor) will be entered as

$$\frac{75 \times 100}{80} = 93{\cdot}75.$$

$\frac{100}{80}$ is called the correcting factor and this figure varies for each crop and each district.

SATHGUDI ORANGE CULTIVATION NEAR TIRUTTANI AND PUTTUR, CHITTOOR DISTRICT

BY S. MUTHUSWAMI,

Agricultural Demonstrator, Tiruttani.

Introduction. *Sathgudi* is one of the best varieties of tight skinned oranges in South India. It must have been introduced in these parts from Sathgur—the original home in Gudiyatham taluk, North Arcot District. The area is about thousand acres in both the divisions and the extent is more in Puttur than in Tiruttani division.

The average area owned by an individual grower is about one acre. There is a great demand for this fruit and consequently the area is gradually increasing every year. Inadequate water-supply in the irrigation sources however seems to be the limiting factor in the extension of the area.

Details of cultivation. *Soil.* The best soil suited for raising this fruit tree is '*Erragulaka*' or (*Erraregada*), red soil up to a depth of three feet with well-drained sub-soil, not less than seven feet.

Seed and sowing. Generally healthy seeds are collected during November and December from well-developed and ripe fruits borne by old trees yielding profusely. The nursery bed is dug with *mamutties* three or four times and brought to a fine tilth. Usually red-soil is preferred for raising seedlings. Fresh seeds are dibbled in the nursery, two inches apart. On every alternate day the seed bed is watered. It takes about a month for the seeds to sprout.

One-year-old seedlings are taken out of the nursery and transplanted in a separate nursery one foot apart, the seedlings being then about a foot high. Before planting this second nursery the soil is dug a number of times and a heavy dose of sheep, goat or cattle manure is applied. Well-powdered *neem* cake is supplied to seedlings to prevent insect attack and to induce dark foliage.

Plantation. Two to four year old seedlings are planted during August—September or January—February in pits dug (six months previously) 15 to 21 feet apart soon after the cessation of the North-East or the South-West monsoon. Just before transplanting the side branches are pruned. Grafts are not generally planted because the belief is, that grafted trees do not yield for a long number of years.

Irrigation. Plants receive irrigation once in three or four days immediately after planting. When watering is done by pots, plants are watered once in two days. After the seedlings are well established they are irrigated twice a week. During the rainy season i.e. (September—December) irrigation is given only if the subsoil is dry. Generally, copious irrigations are given once in four days from February to August in gardens where the trees are bearing.

After Cultivation. Mamutti hoeing is resorted to once in four months round the plants up to a distance of three feet from the trunk when the plants are young. When the trees are bearing the whole garden is ploughed two to three months after the cessation of rains depending on the nature of the soil and young secondary roots are removed to encourage growth of buds. In some cases digging round trees to a width of a foot without injuring roots (except fibrous roots) and removing the soil to a depth of 6″ to 1′ is practised occasionally. Farmyard manure, sheep and goat manure or green leaf compost, tank silt or redsoil is applied round each tree after the resting period (i.e.) about January, the quantity varying according to the age of the plant. Sheep manure is generally preferred. Dead branches are pruned in December—January and the cut ends are tarred. Draining away excess water is also done in ill drained gardens during the monsoon.

Bearing period. The usual flowering season is January to March. Generally trees begin to bear on a commercial scale from the 10th year after planting i.e. when the plants are over 10 years old and they continue to yield up to 40 years. Trees aged over 15 years yield fruit in abundance and continue to do so for a further period of 15 years, when the yield drops.

Yield. Each tree bears on an average 150 fruits. The fruiting season commences in July and lasts till December. In rare cases trees yield fruits from March to June.

Marketing. Fruits are usually exported to Madras packed in bamboo basket. They are sold at the rate of Rs. 3—0—0 per hundred

at the garden. Generally merchants buy from gardeners and export, but a few gardeners directly export the fruits to Madras and sell them wholesale or in retail.

Cost of Cultivation per acre.

	Rs.	A.	P.
Preparatory cultivation ; —			
Digging pits :–Three feet cube 18 ft apart. 135 pits at 0–1–0 per pit.	8	7	0
Manuring and Manures :—			
Green leaf or cattle manure @ 0–3–0 per tree including application.	25	5	0
Seed and sowing :—			
Three year old seedlings @ the rate of Rs. 50 per 100 including labour for planting	68	8	0
After cultivation :—			
Digging round plants by mamutti up to a distance of 3′ four times—10 men @ 0—4 -0 each	10	0	0
Trenching round each plant @ 0—0—3 per plant per year ...	2	1	0
Irrigation :—			
Irrigation once in 4 days from February to August (8×7=56) @ Rs. 1—8—0 per irrigation	84	0	0

Assuming the life of a garden to be 45 years.

Cost of cultivation per year.

Preparatory cultivation (proportionate cost)	0	3	0
Manures and manuring	25	5	0
Seed and sowing (proportionate cost)	1	8	0
After cultivation	12	1	0
Irrigation	84	0	0
Watchmen @ Rs. 3—0—0 per 4 months	12	0	0
Average assessment	10	0	0
Total ...	145	1	0
Yield :—			
150 fruits per tree on an average @ Rs. 3—0—0 per 100 for 135 trees.	607	8	0
Deduct cost of cultivation	145	1	0
Net profit per acre per annum	462	7	0
or Rs.	460	0	0

The writer acknowledges with thanks the suggestions given by Mr. M. Kanti Raj, Assistant Director of Agriculture, Vellore in preparing this article.

THE FIRST GENERATION OF AN INTERSPECIFIC CROSS IN SOLANUMS, BETWEEN *SOLANUM MELONGENA* AND *S. XANTHOCARPUM*

BY Ch. V. SARVAYYA B. Sc., (Ag.),

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Towards the creation of 'larger' variations interspecific hybridisation is often resorted to. The use of wild forms in breeding crop plants, particularly to obtain vigour and resistance to diseases, has come to be well recognised. The present note deals with such a cross in *Solanum* species.

Reciprocal crosses between *S. melongena* and *S. xanthocarpum* were made in the winter of 1934—35 at the Agricultural Research Station, Maruteru. The flower buds were emasculated the previous evening, and crossing effected on the succeeding day when the bud would bloom. The buds after emasculation were enclosed in small muslin covers tightly secured to the peduncle. Crosses with the *S. xanthocarpum* as the pistillate parent were successful, while the reciprocal cross was a failure. As the flowering of the *S. melongena* parent at that time had almost drawn to an end it was then presumed that the late season flowers might be lacking in vigour to set seed. This feature is, however, being investigated. The crosses and the parent seed were sown in well prepared beds on 17—7—1935, and the seedlings transplanted on 6—9—1935.

Characters of Parents. While the detailed botanical description of the parents is reserved for a later publication some of the chief characteristics are mentioned here.

Solanum xanthocarpum, Schrad and Wendl. The plant is a conspicuous herb common in black cotton soils. It has a deep-seated, elaborately branched woody root system, sometimes attaining a length of even three feet. The numerous long greenish yellow spines all over the plant make it very prominent. The stem is somewhat round and covered with sparsely distributed stellate hairs and spreads on the ground. The leaves are simple alternate and pinnately lobed. Secondary lobing from primary lobes is a definite characteristic of this parent. The flowers are rather showy and purplish blue in colour. The flowers are dimorphic with respect to the length of style—long-styled and short-styled flowers. Invariably the two bottom flowers are long-styled ones, while the top ones are short-styled. The plant is highly medicinal and forms one of the '*Dasa mulikas*' of the Ayurvedic medicine. It is largely used in mixtures for colds, coughs, and chronic asthma. The researches in indigenous drugs taken up by the Bengal School of Medicine have confirmed its high place in the medical field.

Solanum melongena—(Brinjal). "This species is an annual erect branching herb, finally becoming subwoody, wooly or scurfy and spiny". The root system is composed of a long tap root with a crown of secondary roots spread in the superficial layers of the soil. Branches are spreading and zig zag due to the sympodial nature of growth. The leaves are simple alternate, sinuately lobed, ovate or ovate-oblong, thick, densely felted stellate hairs. Inflorescence is cymose, extra-axillary, cymes consisting of 4 to 6 flowers. The inflorescence is occasionally represented by solitary flower. Flowers are big, light purple in colour. The flowers are dimorphic with respect to length of style as in the other parent. The solitary i. e., the flower attached in the

bottom of cyme is long styled and the rest are short styled. Tender fruits of this species commonly used as vegetable needs no mention.

Description of the Hybrid. The hybrid is very vigorous, quick growing and spreading. The development of the root system is very interesting. In the seedling stage, the long tap root system with comparatively fewer secondaries resembling that of the *melongena* parent is evident, while in the later stages, an extremely elaborate secondary root system similar to that of the *xanthocarpum* parent appears to develop. Thus the F_1 has the root system of both the parents. The production of the secondary root system however, commences at a later stage than in the *S. xanthocarpum* parent.

The shoot is profusely branched, spreading and prostrate on the ground, studded with thick sharp spines rather more sparsely distributed than in the *S. xanthocarpum* parent. The shoot is sympodial in growth. The stem is round and covered with stellate hairs, whose density of distribution is intermediate between the two parents, *S. melongena* being the denser of the two.

Leaves are simple alternate, pinnately lobed, depth of lobing being intermediate between that of the two parents, deeper lobing being found in the *S. xanthocarpum* parent. Evidences of secondary lobing as in the *S. xanthocarpum* parent are also to be found. The leaf measurements along with the depth of lobing as measured by the perpendicular distance from the midrib to the bottom of the lobe are given below.

Particulars.	Mean length cms.	Mean maximum width cms.	Perpendicular distance from midrib to the bottom of the lobe.	
S. melongena parent	21·69	18·11	5·76	5·55
Hybrid	16·50	10·59	2·88	2·73
S. xanthocarpum parent	11·10	7·14	1·23	1·23

Spines along the midrib, secondary veins and along the petioles of the leaves are present as in the *S. xanthocarpum* parent. The lamina is rather incurved, a feature common in the *S. melongena* parent, but the degree and persistance of this nature is more marked in the hybrid than in the *S. melongena* parent. Stellate hairs are studded as in the stem to an intermediate degree of intensity.

The inflorescence is extra-axillary, cymose, each cyme consisting of 3 to 6 flowers. The extra-axillary nature of the cymes in the *S. xanthocarpum* parent has been exclusively emphasised in the F_1. The stalk of the cyme and the pedicels of the flowers are sparsely studded with spines. In the cross, the two kinds of arrangement of flowers as occurring in the two parents are to be found in almost equal proportions. The flowers are dimorphic as in the two parents.

The flower is intermediate in size and is of the same morphology as that of the parents. But, the corolla is bent backwards, a behaviour

inherited from the *S. xanthocarpum* parent. The stamens are intermediate in size. The ovary is round ; fruit, globose berry with the characteristic check pattern design like that on the berries of the *S. xanthocarpum* parent, the purple heading to an intensity from the top of the ovary to the stalk end. The fruits are only slightly bigger than the *xanthocarpum* parent.

Setting on the fruits is poor both under natural pollination and artificial self-pollination. Back crosses with the two parents are fairly successful, using the hybrid as the pistillate parent.

Pigmentation. The inheritance of the pigment in the several parts of the plant is noted below :

Particulars.	*S. xanthocarpum* parent.	Hybrid.	*S. melongena* parent.
Stem	Light purple	Medium purple	Light purple
Leaves and veins	Green	Purple	Purple
Spines	Green	Purple	No spines
Corolla	Medium violet	Deep violet	Light violet
Fruit	Light green with dark green check pattern design at the distal end.	Same as in *S. xanthocarpum* parent with purple wash all over.	Purple

The partial sterility of the hybrid, while necessitating further investigation of the controlling factors, sets a handicap to the progress of the inheritance study.

NUTRITION, INTERNATIONAL AND NATIONAL

By W. R. AYKROYD, M. D.,

Director, Nutrition Research, I. R. F. A., Coonoor.

During the last year the subject of nutrition has received considerable attention from the League of Nations and the related organisation, the International Labour Office. As a result of international discussions, comprehensive schemes for the study and attack of the problem have been formulated, which are likely to have a considerable influence in the spheres of economics, agriculture, and public health.

In the Report of the Director of the I. L. O. to the Nineteenth Session of the International Labour Conference (June 1935), we find the following passage :—

"Though there is still considerable controversy among physiologists as to the minimum needs for healthy subsistence and as to the rations of calories, proteins, mineral salts and vitamins required in different climatic conditions, it is not open to dispute that large masses of people are at present under-fed or wrongly fed. ....Every country is faced by a problem of this kind, but its exploration is only just beginning. It may be compared with the problem of medical treatment and maternity care, for which much has already been done wherever a sound system of health insurance has been established......... If the cure and prevention of disease is a communal affair, housing and feeding, which are the primary requisites of healthy living, are hardly less so. They were certainly not excluded from the purview of the International Labour Organisation by the Preamble to the Constitution, which lays down the 'provision of an

adequate living wage' as one of its objectives and declares it urgent to improve conditions of labour involving hardship and privation.'

"Looked at from another angle, it is evident that a higher and more variegated standard of food consumption would go far to solve the problem of agricultural over-production........."

"This question of consumption is not only national but international in its scope. If it is agreed that the only real solution of the problem of economic balance is not through scaling down production but in levelling up consumption, then it follows that the best hope of finding a way out of the present troubles is to raise the standards of the millions who are now underfed, under-clothed and under-equipped. The cares of the American, Argentine, Australian, Canadian or Eastern European farmer would be conjured away if the urban population of Europe and America could eat even a little more bread, butter and meat per head......... When all other remedies have been clearly seen to fail, it is in this direction that thought will eventually be directed, unless a general regression towards lower standards of living is accepted as the ironical but inevitable outcome of a civilisation condemned to decline through the excess of its own creative ingenuity and technical perfection."[1]

An interesting discussion of the questions raised in these paragraphs ensued at the Conference, in the course of which various delegates stressed the importance of nutrition in relation to agriculture, economic policy, and the purchasing power and health of industrial workers. The Conference adopted a resolution instructing the Labour Office "to continue its investigation of the problem, particularly in its rural aspects in collaboration with the health and economic organisations of the League of Nations, the International Institute of Agriculture and other bodies capable of contributing to its solution, with a view to presenting a report to the 1936 Session of the Conference."

During the Sixteenth Session of the Assembly of the League of Nations (Sept. 1935), delegates of 12 countries, including the United Kingdom, Australia, the Argentine, Chile Italy, and Sweden, addressed a letter to the President proposing that "the question of the relationship of nutrition to the health of the population, which has become a social and economic problem of widely accepted significance, and is recognised as having an important bearing on world agricultural problems, should be placed on the agenda of the current Session of the Assembly."

This was accordingly done, and the discussion raised lasted three days in the Second Committee—a somewhat remarkable fact when one remembers that the 1935 Assembly was perturbed by the tragedy of the Italo-Abyssinian war. A few months previously a report had been published in the *Quarterly Bulletin of the Health Organisation of the League of Nations* entitled "Nutrition and Public Health."[2] by Dr. Et. Burnet of Paris and myself. This report, which marshals evidence to show that malnutrition is prevalent throughout the world and outlines the far-reaching implications involved, was to a large extent used as a basis for discussion In opening the debate, Mr. Bruce, the Australian delegate, used the memorable phrase "marry health and agriculture", which served to crystallise ideas previously nebulous. Other delegates who spoke were in general agreement that the time has come for vigorous action on a national and international scale, and the bearing of the ideal of "improved nutrition" on the economic life of the world was reemphasised. Increase consumption of agricultural products and the purchasing power of the agriculturist must rise, to the benefit of industry and world trade in general. As a result of its discussions, the Assembly set up a "Mixed Committee" including agricultural economic, financial, and health experts, who are to submit a general report on the whole question, in its health

and economic aspects, to the next Assembly, and further, it instructed the technical organisations of the League to "collect, summarise, and publish information on the measures taken in all countries for securing improved nutrition."

The next necessary step was to define "optimum nutrition" in the light of modern knowledge. This was done in November, 1935, by a Technical Commission, convened by the Health Organisation of the League, which included leading nutrition workers from U. S. A. and various European countries. Its report, entitled "The Physiological Bases of Nutrition,"[3] defines in simple language a series of optimum dietary standards. Those interested should study the report in the original. Among the points emphasised by the Commission were the following:— the importance of a high milk intake, particularly for children and expectant and nursing mothers; the value of green and leafy vegetables, fruit, eggs and unmilled cereals; the undesirability of a high consumption of milled cereals and sugar. It was subsequently pointed out by various authorities that the general adoption of a diet of the type recommended by the Commission would mean, even in a comparatively well-fed country like England, a very great increase in the demand for dairy products, eggs, fruit vegetables, etc., and that such a demand would enormously stimulate the agricultural industry. The ideas of our 'over-production' in agriculture, and of restricted production as a way out of the economic depression, seem to be finally defunct. It has become ludicrous to talk of the 'over-production' of food-stuffs a world, a great proportion of whose inhabitants are living on a diet far below optimum standards.

The fundamental problem (as far as the countries of Western civilisation are concerned) is therefore to stimulate food consumption in the right direction, and this clearly is a problem with many aspects each requiring intensive study. First, there is the question of educating the mass of the people in rational dietetics. There is great scope for advance here, but difficulties should not be underestimated. The average human being is not very teachable about his diet, being convinced that he knows all there is to know about the subject already. Untiring effort is required to make scientific knowledge, even in a rudimentary form, the property of the man in the street. Then there are difficulties inherent in the commercial organisation of the world; vested interests are quick to turn to their own advantage any new movement of this kind, and ingenious advertising of expensive and unnecessary food products might tend to drown the less sensational propaganda of the hygienist.

At best, however, the possibility of improving nutrition by purely educational means is limited. Poverty is a more basic cause of malnutrition than ignorance. To a large extent, as far as the poorest classes in many countries are concerned, diet is determined by income, and without increase in purchasing power no great improvement is possible. Obviously, purchasing power cannot be raised by a wave of the hand. But at least it is possible to investigate on a wide scale the relation between income, the "cost of living" and food consumption, and correlate the consumption of a minimum wage with that of a minimum adequate diet. There are questions of special interest to those concerned with labour problems, and they are at present being actively studied by the International Labour Office.

In countries like England, the subsidising of certain branches of the agricultural industry (e. g., dairy products, eggs, fruit and vegetables) would stimulate production, and lower prices to the benefit of the consumer. Again, an increased national expenditure on unemployment, benefit, the supply of milk and nutritious meals to school children, pregnant and nursing mothers, etc., an improvement in the feeding of residential institutions under governmental control, would ultimately have a beneficial effect on the health of a large section of the population, and at the same time put more money in the farmer's pocket.

The " Mixed Committee " of the League, which met in February, 1936, under the presidency of Viscount Astor, included representatives of the International Institute of Agriculture, the International Labour Office, and a number of distinguished nutrition, economic, and agricultural experts. In an interesting opening speech Viscount Astor outlined the enormous range and implications of its proposed activities. On the whole he was optimistic :—

" I believe that our final recommendations can and will make an overwhelming appeal to the common sense of the world............ If starting from the aspect of public health and continuing our enquiries through the fields of national agriculture, of world trade, of industrial employment we come to the conclusion that welfare, using this word in its widest meaning, can be immeasurably raised through the application of the results of science, we shall open up a new era of progress to a suffering world."

It is clear that this promising international activity closely concerns India and the East. Before long India will be drawn into the orbit of the investigation, and will be able to benefit from the results of enquiries carried out elsewhere. As a preliminary there is a great deal of work to be done in India to clarify the general situation as regards nutrition. It is first of all necessary to correlate and compare agricultural production, etc., with the food requirements of the population, and incidentally to throw light on the so-called population problem. This, in my opinion, is infinitely the most urgent and important task to be undertaken in connection with nutrition in India ; in the absence of this basic information, the possibility of improving the diet of the people on a wide scale cannot be assessed.

On the economic side, investigations among both urban and rural groups are called for ; any study of the economic condition of population groups indirectly throws light on diet. In the sphere of public health, more active educational and propaganda work is needed, and a great deal of further research, involving many areas of the country, into the effects of malnutrition of the individual, should be set on foot.

Present League activities centre round the ideas that the diet of the mass of the population in almost all countries falls below " optimum " standards, that increased demand for nutritious food will result in increased production, and that the world as a whole is capable of a very much greater production of foodstuffs, and in particular of the physiologically most valuable foodstuffs. It is proposed that national and international " food policies " should be boldly constructed on the principles implied in Mr. Bruce's phrase—" marry health and agriculture ". If India is considered as a self-supporting unit, the problem takes on a somewhat different complexion ; many consider that there is little possibility of the country producing an improved diet for its rapidly increasing population. We need, however, much more information on this point. If, on the other hand, we regard India, not as an isolated unit, but simply as part of the world, the ideas formulated at Geneva seem to become more applicable. It is conceivable, for example, that increase of wealth and purchasing power would enable the country to benefit, by importation of the kind of foodstuffs she most needs, from a world-wide boom in agriculture. At all events, there is no reason why an attempt should not be made, when the fundamentals of the situation have been more fully investigated, to formulate a " food policy " on a national or provincial basis. (*Current Science*, March 1936.)

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1. International Labour Conference. Nineteenth Session, Geneva, 1935, Report of the Director, pp 83–84.
2. June, 1935, Vol. IV, No. 2.
3. *C. H.*, 1197, Geneva, December 1935.

Gleanings.

A Golden Jubilee. On 6th December 1935, the Society of Plant Pathology and Agricultural Entomology of France, held at the Natural History Museum in Paris, a meeting to celebrate the memory of Professor Millardet and the Fiftieth Anniversary of his discovery of Bordeaux Mixture in 1885. (*Int. Review of Agri.* Jan. 1936).

Hear this about the white Elephant! A white elephant with pink eyes--a true albino—was killed not long ago by a game warden on the plains of Laikipia, in Kenya colony, South Africa. Like all white elephants, the animal was in reality gray, but every hair on its body was white. The Kenya game warden's report relates terrible effects on wild life, of three years of drought. There are records of elephants falling into wells and perishing, because they were too weak to get out again. A number of rhinoceroses, and many buffaloes have also died in their frantic efforts to get water. In northern Kenya, herds of wild elephants hid behind cattle while natives dug for water, and when it was found, stampeded forward to get the first drink.

Soaking Seed Cane before Planting. Two experiments were made to investigate the effect of soaking on the germination of cuttings and on the final yield of cane, both plant and first ratoon. There were five treatments: (1) soaked in a saturated solution of lime; (2) soaked in a solution of lime containing also one pound of magnesium sulphate per 50 gallons; (3) soaked in a complete nutrient solution containing all plant food; (4) soaking in water alone; (5) no soaking. In one experiment the soaking was for a period of 8 hours, in the other 16 hours.

In both experiments the yield of cane from the seed cane that had been soaked in (1) the lime, and (2) the lime and magnesium sulphate solutions, was significantly better than the yield of cane grown from seed cane that was not soaked and also better than from the treatments (3) and (4). There was no significant difference between soaking in lime solution alone, and lime solution plus magnesium sulphate. Hence preference is given to the method of soaking in saturated lime solution, because it appears to be the simplest. Both experiments were extended to include the first ratoon crops from all treatments. In the plant cane the increase of yield from the cane soaked in lime water was about 25 per cent., in the ratoon crop about 17 per cent.

The author has made some investigations with a view to finding an explanation of why soaking the seed pieces results both in a better germination and a larger yield of cane. It was first thought that the soaking would initiate a rapid hydrolysis of sucrose, which would speed up the germination process. It could not be shown that soaking had any marked effect on the rate of hydrolysis. It was then thought that the nature of the solution would have some effect on the amount of water absorbed by the seed pieces. By experiment it was found that the pieces actually absorbed significantly more water from the lime solution than from pure water, and this appears to provide the answer to the question. The pieces that have been soaked in the lime solution have absorbed more moisture, and therefore germinate faster when planted; this rapid germination assures a more vigorous growth.

While soaking in the lime solution resulted in an increased percentage of germination, there was still a certain number of failures. By a special investigation it was found that the most uniform stands (lowest percentage of blanks or misses) were obtained when the planting material was taken from young cane, or the top portions of old cane; this means that the best planting material is that

containing the largest percentage of invert sugar. Obviously when such material is soaked in lime water, one condition will be provided that will help to give the best stand and the largest yield. (Extract from *Facts about Sugar*, Vol. 30, 12, 1936).

Germination studies on Sugar cane. Pieces of seed cane were soaked for 24 to 48 hours in solutions of various materials; among these, extract of ashes and a saturated solution of lime and magnesium sulphate (1 : 50) showed a more favourable effect on percentage of germination than water alone, and a much better germination than was obtained with unsoaked seed pieces. The more mature parts of the cane stalk benefited most from soaking. It has been found useful to keep canes standing vertically in drums with their cut ends wholly immersed in in water to ensure uniform germination of middle and top pieces.

Germination tests with material cut every month and kept in an incubating chamber maintained at 72—78°F. show that the best germinations obtain in monsoon from young canes. High glucose ratio and moisture per cent in cane seem to have a significant bearing. Critical point of moisture percentage in cane seems to be 50·3, below which very poor germinations were realised. Critical point of moisture percentage in cane buds of Co. 213 was, however, found to be only 40·0. On further dessication they lose power to revive even on soaking. Younger buds borne on the top of cane shrivel up and dry more quickly than mature buds, which dry up comparatively slowly. Form and shape of bud and its position on the stalk also influence to a certain extent rate of dessication. Other points studied show relationship between wax or bloom present on cane-stalks and germination. Varieties having a thicker coating of wax show tardier germination under low soil moisture conditions. With high moisture content, differences are, however, less marked.

Capacity of absorption at surface varies with the qnantity of wax present and the hardness of rind, and seems positively correlated with high germination. Similarly, rapidity of sugar hydrolysis on soaking seems to indicate whether variety would result in quick germination. (K. L. Khanna, *Dip. Agri. Bihar and Orissa, Bull. 6.* (1934)—Abstracted in "*Sugar*" Feb. 1936).

Paper from Maize stalks. Difficulties in the manufacture of paper from maize stalks arise from the structural peculiarities of the stems. The cortex contains fibres shorter than those of the most commonly used woods, but, nevertheless, of paper-making quality; whereas the soft, spongy, inner pith consists chiefly of thin walled cells of little use for paper-making. Furthermore, hard nodes occur in the cortex and must be crushed in order to obtain an evenly cooked pulp. An excessive amount of dirt is also liable to be present.

A series of laboratory and semi-commercial tests were carried out, using the material in three different forms, viz. (1) the stalks in 1 in. lengths (2) the shredded stalks, (3) the separated and washed cortex. Papers were made by the lime, caustic soda and sulphate processes, and details are given of the yield of pulp and the qualities of the paper obtained in each trial. The cleanest, strongest, best working papers were produced from the separated cortex, which yielded only 5 per cent less pulp (expressed on the original baled stalks) than was obtained from treating either the cut or the shredded stalks. As moreover the original material requires twice the quantity of chemicals and twice the digester capacity needed for the cortex, which amounts to only 43 per cent. of the original material, the advantage and economy of using the cortex only is evident.

It is estimated that 5·2 tons of maize stalks would be required to give enough cortex to produce 1 ton of pulp suitable for white papers. Assuming that the price of the stalks at the mill is 7·15 dollars per ton and that $1 per ton must be allowed for the separation of the cortex, the cost of the stalks would be 42·38 $. per ton of pulp. This is about 60 per cent. greater than the cost of the spruce

wood required for a ton of sulphite pulp, and in addition the conversion and handling costs would be higher.

In conclusion, the authors express the opinion that, on account of the relatively high cost of the raw material and the expense of converting it into pulp, the manufacture of paper from maize stalks is not at the present time a commercially feasible venture. Only if sufficiently profitable uses could be developed for the pith and fine fibrous material left after separating the cortex, could the stalks become of interest to the paper-maker. (*Bull. Imp. Inst.*, Jan. 1936).

This is Japan's way. Japan has come forward with a new plan to bring relief to her unemployed. We understand that the Japanese Bureau of Social Affairs has recently established a scheme of camps for men engaged on unemployment relief works. The object is to give the unemployed the instruction they require, particularly with a view to occupational re-training. Expenditure on the scheme in 1936 will amount to 3,570,000 yen. About 90,000 unemployed workers without means drawn from the six largest cities of Japan, will be engaged on the relief works for at least six months and housed in the camps. Arrangements have been made for 60 teachers to supervise camp life and instruct the men. The authorities will do their best to provide men leaving the camps with employment corresponding to their newly acquired abilities; and special steps will be taken to encourage them to emigrate. (*Mys. Ec. Journal*, Jan. 1936).

Production of Artificial Silk continues to increase. The German Artificial Silk Industry, concerning which official figures have now been published, experienced a further marked up-swing. Total production was 48·2 million Kg. or an increase of 42 per cent. over 1933 and 62 per cent. over 1932......... Sales of German establishments have increased considerably, indeed from 33·6 million Kg. in 1933 to 52·3 million Kg. in 1934 or round about 56%. Exportation has however, declined. (*Ind. and Eng. Chem.*, Vol. 14, No. 3, P. 38).

For the Fads.

Methusaleh ate what he found on his plate,
And never, as people do now,
Did he note the amount of calorie count.
He ate it because it was chow,
He was not disturbed, as at dinner he sat,
Destroying a roast or a pie,
To think it was lacking in granular fat
Or a couple of vitamins shy,
He cheerfully chewed every piece of food,
Untroubled by worries or fears,
Lest his health might be hurt by some fancy dessert,
And he lived over nine hundred years!

(*Scient. Amer.*, March 1936, P. 120).

What an escape! It is fortunate for human beings that one ancient insect became extinct. Fossil remains discovered near Elmo, Kansas, by Dr. Frank M. Carpenter of the Howard Museum of comparative Zoology, show that this particular dragon fly which lived 150,000,000, years ago, was nearly two and a half feet long. (*Sc. Amer.*, March 1936).

ABSTRACTS

Studies on the coconut palm III. Husk. A. The manurial value of coconut husk ash. by M. L. M. Salgado—*Trop. Agri. Cey.* March 1936, P. 131. A paper that records the analyses of coconut husk ash carried out in order to assess its manurial value. The author finds that the coconut husk ash contains as much as

35% of water soluble potash and about 2% of phosphoric acid, in addition to other ingredients like calcium (2%) carbonates (13%) Magnesium (2%) Sodium chloride (23%) etc.

Further as the result of an interesting experiment, in which coconut husks were ashed before and after retting them, it was found that as much as 50% of the potash present in the husk, was lost during retting, (ie.) by mere solution in the retting water. The author therefore advises that where husks have to be ashed for use as a manure, they must be husked when they are fresh and not after undue exposure, as monsoon rains received during the period of storing the husks in a corner of the garden, are likely to leach out the soluble potash.

The author computes that according as the soil is loamy or gravelly the yield of potash from 1000 husks, will vary from 10 to 15 lbs. M. R. B.

Review.

Principles of Forest Entomology : By S. A. Graham. Pages 1–339 (with figures) 1929 (First Edition). Published by *Mc Graw-Hill Book Company Inc.*, New York and London.

This book forms one among a series of Mc Graw-Hill publications in the Zoological Sciences edited by A. Franklin Shull ; and is intended for all interested in the protection of forests and forest products.

The subject matter of the book is divided into 17 chapters as follows:— *Chapter I.* Introduction wherein the author deals with the importance of forest entomology, losses due to forest insects, scope and sub-divisions of forest entomology ; *Chapter II.* Historical review of the development of Forest Entomology in Europe and in America ; *Chapter III.* Biotic Potential dealing with rate of multiplication, sex-ratio and calculation of Biotic Potential ; *Chapter IV.* Environmental resistance such as physical factors, nutritional factors, plant physiological factors, and biotic factors ; *Chapter V.* Insect abundance dealing with biotic balance and devices to increase abundance ; *Chapter VI.* Direct control of tree insects dealing with purpose and cost of control and classification of control measures, direct control by biotic methods ; *Chapter VII.* Direct control by chemical methods dealing with feasibility of chemical methods, application of insecticides and the classification of insecticides ; *Chapter VIII.* Indirect control of tree insects dealing with control by modification of food-supply, modification of moisture conditions, and modification of temperature ; *Chapter IX.* Indirect biotic methods and silvicultural practices dealing with indirect biotic methods such as the use of competition, control by parasites and by predators and silvicultural practices ; *Chapter X.* Leaf eating insects dealing with defoliation, Lepidopterous leaf eaters, Coleopterous leaf eaters and Hymenopterous leaf eaters ; *Chapter XI.* Meristem insects of the terminal parts dealing with groups of meristem insects, insects feeding on the tips and feeding on the roots ; *Chapter XII.* Meristem insects of the cambium region dealing with cambium borers and bark beetles ; *Chapter XIII.* Cambium-wood insects viz., pests of living trees and pests of drying trees and logs ; *Chapter XIV.* Wood destroyers such as unseasoned wood insects, moist dead-wood insects, marine wood borers and dry wood insects ; *Chapter XV.* Sapsucking insects such as Hemipterous insects, some Homopterous insects and scale-insects ; *Chapter XVI.* Insectivorous parasites such as entomophagous micro-organisms and parasitic insects ; *Chapter XVII.* Insectivorous predators viz., predatory insects and other predators.

At the end there is an exhaustive bibliography (pages 306—317) given chapter by chapter, about 300 references in all. And there is an index running from pages 319—339.

The author himself says at the outset in the preface that the book instead of being primarily a text book "should be of interest not only to students and teachers of forest entomology, but also, to economic entomologists, ecologists, foresters......... The book does not in any way deal with classification, structure, anatomy, metamorphosis etc.. as a text book usually does, but deals on some broad principles on which economic entomology is based from an ecological point of view " supplemented by a study of certain insect species carefully selected to illustrate how these principles apply in individual instances ". Even from a run at the subject dealt with in the several chapters it can be seen that the book is more or less of a general nature and consequently forms a convenient hand book for an economic entomologist, whether he be a forest entomologist or one who has to deal with agricultural crop-pests. And it can form a companion volume to Folsom and Wardle's " Entomology with reference to its Ecological Aspects."

The following insects are dealt with in the course of the work viz; the Spruce Bud-worm the gypsy Moth, the cankerworms, the Elm Leaf beetle, the poplar Leaf beetle, the Larch saw-fly and the pine sawflies among the leaf eating insects; the Pine Tip moth, the Pales weevil, the white pine weevil, the white gribs and other small root insects among the meristem insects of the terminal parts. The pine Pitch mass borer, the sugar maple borer, the two lined borer, other species of Agrilus among the cambium borers and the Black Hills beetle and the pine Bark beetle among the bark beetles; the Locust borer, the Aspen borer and the carpenter moth, among pests of living trees and the flat headed borer and the small pine sawyer among the pests of drying trees and logs; the Ambrosia beetles and Horntails among the unseasoned wood insects, the carpenter Ant and the *parandra* borer among the moist dead wood insects; the shipworms and the wood Louse among the marine wood borers; and the Termites and the powder post beetles among the dry wood insects; the plant bugs and the Lace bugs among the Hemipterous insects; the periodical cicada, the Aphids and the Adelgids among Homopterous insects; and the Oyster-shell scale, the cottony Maple-scale and the European Elm-scale among the scale insects.

One interesting feature in the book is that beginning from chapter X, dealing with the different kinds of insects, at the end of each insect under reference, are found questions on literature pertaining to such points as the outbreak of the pest, food plants, secondary insect pests usually associated with the primary one, the period of attack on the tree, nature and extent of attack, susceptibility to or resistance from injury, introduction of parasites and their establishing, important parasites met with, control measures such as spraying, tree banding whether the pest is indigenous or otherwise, geographical distribution, environmental factors, biotic potential, the different broods, details as regards life-cycle which have got a bearing on controlling the insect pest. The questions in themselves would suggest the lines on which any insect problem can be tackled.

The chapters on biotic potential, environmental resistance, insect abundance, and those dealing on control methods are very illuminatingly written in such a small compass. While dealing with other indirect control measures the author gives a short account on ' control by parasites" and the portion is worth reading, for he has brought in a nutshell the different aspects of biological control and adduces the several factors on which the effectiveness of a parasite in controlling insect pests depends. And in order that a given parasite may be effective its requirements have been summed up thus " it should have a high biotic potential; it should be synchronized with its host in such a way that the adult parasites are flying during the time when the susceptible state of the host is available; it should be able to feed upon more than one species of host; it

should not be restricted in its multiplication by the necessity of spending an alternate generation in a host that does not occur abundantly ; it should be able to compete successfully with other parasites when double parasitism occurs; finally it should be able to reach and parasitize a large proportion of the potential hosts.

He makes an interesting observation to the effect that "The success of fungus and bacterial diseases in reducing insect abundance depends so much upon favourable weather conditions that the use of these organisms offers comparatively little promise at the present time."

The get up of the book is on a par with other publications in the same series. V. M.

Research Notes.

The Occurrence and Inheritance of Yellow Coloured Anthers in the Italian Millet—*Setaria italica* (Beauv).

In *Setaria italica* two fresh anther colours are met with, viz., brownish-orange and white. These, when dry and seen *en masse* appear brownish-black and buff-yellow respectively. These colours form a simple Mendelian pair, with orange dominant (G. N. Rangaswami Ayyangar and T. R. Narayanan, 1932, Ind. J. Agric. Sci. 2 : 59).

In the course of further work yellow coloured anthers (drying brown) have been met with in the following varieties :—

Number.		
S. I. 102	...	From India.
S. I. 2657	...	„ Russia.
M. S. 3422	...	„ China.

The relationship of these yellow coloured anthers to the other colours, brownish-orange and white, has been determined by suitable crosses.

TABLE I.

Yellow anther X Brownish-orange anther, F_1—Brownish-orange anther.

Cross No.	F_2 Family No.	Segregation for	
		Brownish-orange anther.	Yellow anther.
(S. I. 102 × S. I. 419)			
S. I. CCCLXXXIX	S. I. 2679	216	83
S. I. CCCXCI	S. I. 2680	187	60
	S. I. 2681	191	69
(S. I. 2657 × S. I. 2120)			
S. I. CCCXCII	S. I. 2682	184	72
S. I. CCCXCIII	S. I. 2683	138	54
	Total	916	338
	Expected 3 : 1	940·5	313·5

$x^2 = 2{\cdot}6 \quad P > {\cdot}05$

TABLE II.

White anther X Yellow anther, F_1—Yellow anther.

Cross No.	F_2 Family No.	Segregation for	
		Yellow anther.	White anther.
(S. I. 2528 × S. I. 2657) S. I. CCCXCVII	S. I. 2684	160	45
	S. I. 2685	83	27
	S. I. 2686	94	31
	Total	337	103
	Expected 3 : 1	330	110

$x^2 = \cdot 6$ $P > \cdot 05$

It will be noticed from the above that yellow anthers are dominant to white anthers and recessive to brownish-orange anthers. This new character adds to the list of varietal characters helping in the classification of varieties of Italian millet.

Millets Breeding Station.
Coimbatore, March 4, 1936.

G. N. Rangaswami Ayyangar.
P. V. Hariharan.

College News & Notes.

Students' Corner. The students being busy about their examinations, which are held during this month there was a lull in their athletic activities. On 19—3—36, the students of I & II year were at home to the final years, and speeches were made by the Principal, the representatives of two classes, and others bidding them farewell and wishing them success in their examinations. The teaching staff. gave them a tea, on 29—3—36, and the Warden, Mr. H. Shiva Rao on 4—4—36.

Badminton and Bridge Tournaments. The Badminton Tournament organised by the Sugarcane Club, Chettipalayam, and the Bridge Tournament organised under the joint auspices of the Sugarcane Club and the Officers' Club, came off during the Easter Holidays, and were a great success. Messrs. Viswanatha Iyer and Srinivasa Iyengar of the Officers' Club won the Bridge Cups, Mr. Naick and partner being runners up. The following were the winners and runners up in the badminton tournaments :

Fives :	M. Y. M. A., Coimbatore	(Winners).
	Coonoor	(Runners up).
Doubles :	Viswanatha Iyer & Sankaran Nair	(Winners).
	Ramachandran & Ramawami	(Runners up).

Joint Easter Session. The Joint Easter Session of the Indian Science Academy. the Association of Economic Biologists, the Indian Chemical Society, was held at Bangalore and a few representatives from Coimbatore visited Bangalore in this connection.

Obituary. We regret to record the deaths of Mr. V. Muniappa Pillay, Veterinary Officer, who was for sometime lecturer in our College and Mr. Kalingarayar, Zamindar of Utukulli, one of our esteemed Patrons.

Visitors. M.R.Ry. Rao Bahadur D. Ananda Rao Garu, Director of Agriculture, and M. R. Ry. P. H. Rama Reddy Garu, Secretary, Indian Central Cotton Committee are on a visit to Coimbatore.

Weather Review (MARCH 1936).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	0·0	−0·5	4·8
	Berhampore*	0·4	−0·4	5·5
	Calingapatam	0·2	−0·2	3·0
	Vizagapatam	0·1	−0·2	4·9
	Anakapalli*	0·2	−0·4	0·0
	Samalkota*	1·1	+0·9	8·6
	Maruteru*	0·0	0·0	4·1
	Cocanada	0·1	−0·4	4·7
	Masulipatam	0·0	−0·3	4·4
	Guntur*	0·0	−0·2	8·1
Ceded Dists.	Kurnool	0·0	−0·3	1·7
	Nandyal*	0·5	+0·4	1·6
	Hagari*	0·7	+0·5	1·6
	Bellary	0·3	+0·1	0·3
	Anantapur	0·1	+0·1	0·1
	Cuddapah	0·3	+0·2	0·7
Carnatic	Nellore	0·0	−0·2	1·9
	Madras	0·9	+0·7	3·5
	Palur*	1·3	+0·0	3·7
	Palakuppam*	2·0	+0·5	3·6
	Cuddalore	2·0	+1·8	4·1
Central	Vellore	0·3	+0·1	1·0
	Hosur cattle farm*			
	Salem	0·5	0·0	4·1
	Coimbatore	2·0	+1·5	3·4
	Coimbatore Res. Inst.*	1·7	+0·9	2·9
	Trichinopoly	0·7	+0·3	1·7

Division	Station	Actual for month	Departure from normal @	Total since January 1st
South	Negapatam	4·2	+3·9	8·4
	Aduthurai*	3·5	+2·3	5·6
	Madura	2·7	+2·2	5·3
	Pamban	1·4	+0·9	3·0
	Koilpatti*	3·6	+2·7	4·9
	Palamkottah	2·6	+1·6	4·2
West Coast	Trivandrum	3·1	+1·5	3·5
	Cochin	1·4	−0·6	2·7
	Calicut	7·1	+6·6	10·4
	Pattambi*	4·6	+4·1	5·2
	Taliparamba*	0·9	+0·5	0·9
	Kasargode*	2·4	+1·9	2·5
	Nileshwar*	1·3	+1·0	1·6
	Mangalore	2·9	+2·8	3·7
Mysore and Coorg	Chitaldrug	0·2	−0·1	0·3
	Bangalore	1·0	+0·4	1·0
	Mysore	2·4	+2·0	2·6
	Mercara	3·5	+2·9	3·9
Hills.	Kodaikanal	6·1	+4·1	6·9
	Coonoor*	10·6	—	14·8
	Ootacamund*	3·7	+2·8	4·6
	Nanjanad*	4·3	+3·4	5·2

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Summary of Weather Conditions. During the first half of the month the weather was generally dry in the Peninsula except for a few thunder showers in Malabar and Cochin. The humidity was generally in defect. The skies were lightly to moderately clouded. The maximum temperatures were generally below normal and the minimum above normal.

During the second half of the month thunder storms have caused general rain in Malabar, local rain in South and South East Madras and a few showers in North Madras. The skies were moderately to heavily clouded during this period.

Weather Report for Research Institute Observatory.

Report 3/36.

Absolute Maximum in shade	97°F.
Absolute Minimum in shade	62·8°F.
Mean Maximum in shade	94·1°F.
Departure from normal	− 0·4°F.

Mean Minimum in shade	+70·5°F.
Departure from normal	+ 1·1°F.
Total Rainfall	1·72"
Departure from normal	+ 0·92"
Heaviest fall in 24 hours	1·10" (Recorded on 18th).
Total number of rainy days	2 days.
Mean daily wind velocity	1·5 M. P. H.
Mean Humidity at 8 hours	73·4%
Departure from normal	+ 3·7%

Summary. Dry weather prevailed during the first two weeks of this month. The minimum temperature was above normal by 1·1°F. The humidity was in excess of the normal by 3·7%. Local thundershowers yielded 1·72" of rain during this month. The skies were moderately to heavily clouded.

Departmental Notifications.

Gazette Notifications. M. R. Ry. S. Dharmalinga Mudaliar to be offg. Supt., A. R. S., Maruteru, Vice, M. R. Ry. K. Venkataraman on leave.

Mr. P. Krishnamurti, A. F. M. Anakapalle, l. a. p. for 3 months from 15—4—36 with permission to prefix Easter holidays.

Transfers. Mr. M. Kandaswamy, Offg. Agricultural Demonstrator, Coimbatore is posted to Annur Sub Circle. Mr. K. C. Thomas to Tirupur. Mr. S. S. Kachapeswara Iyer to Tirupur as Temporary Secretary, Tirupur Market Committee for a period of 6 months. Mr. Krishna Hegde, A. F. M. Pomological Station, Coonoor, to Botanical Garden, Octacamund.

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Editorial.

The Viceroy and Livestock Improvement. The Marquess of Linlithgow, the Agricultural Viceroy has within a short time of his arrival in this country, given a practical demonstration of his interest in the development of agriculture. The Royal Commission had recognised that the prosperity of Indian agriculture was closely linked with the improvement of livestock and their report had dealt with a number of suggestions. The Viceroy, the Chairman of that Commission has shown by personal example what actually might be done by private individuals to implement the recommendations of the Commission. As the Viceroy pointed out "the cow and the working bullock have on their patient backs the whole structure of Indian Agriculture" and the best way of helping the cultivator would be to improve the breed of cattle all over the country.

The problem involved in the improvement of cattle in India is twofold, firstly the improvement of the milk yields of individual cows and secondly the production of animals for speed and working capacity. The importance of milk in the diet of the people has come to be recognised all over the world. If even in countries like England, Germany and Italy which are far ahead of India in livestock improvement work, there is found a necessity for a campaign of "drink more milk" how

much more should it be necessary for India might be easily imagined. It has been stated that except in the Punjab the quantity of milk consumed in the rural areas of the provinces in India is seriously inadequate. There is not enough of the 'protective food' milk in the country and health experts have been pointing out that the physical impairment and defects noticeable in school children are in a large measure due to deficient feeding, and want of sufficient milk in the diet, during infancy and early childhood.

It was generally believed in earlier days that a herd of good milkers can be produced only by crossing the indigenous cows with the imported Ayreshires. The opinion has since been revised and it is now recognised that some of the special breeds indigenous to India like the Sahinwal, the Hariana and the Scindhe can be used just like the Ayreshires. These breeds with proper attention to breeding, feeding and management are found to stand comparison with the best breeds of the Western countries. In our own province the introduction of the Scindhes has been of a definite advantage in improving the milk yields of cows.

The question of breeding dual-purpose cattle in India, which in addition to producing working bullocks would also provide good milch animals, has often formed the subject of discussion amongst the Departmental officers. With the experience gained so far the right policy would appear to be to continue to breed for work in the natural grazing areas where the development of dairy industry on modern lines would not be feasible, and to breed for highest milk yields in special herds and in suitable areas with the development of the dairy industry in view. It does not mean however that the two view points are incompatible. The experience with the Scindhe herd in Madras has been that the cows of the breed are definitely better milkers than the local breeds and the bullocks are quite satisfactory except probably in road work where quickness is an important consideration. That the milk yields in the two purely work breeds of South India, the Kangayam and the Mysore can be improved by systematic breeding has been demonstrated by the work of the Madras and Mysore Agricultural Departments. The most important point in effecting such improvement is the availability of good pedigree bulls. The ordinary cultivator who requires a general utility animal can get his needs met if pedigreed bulls of definite breeds are placed within his reach. The importance of this question has been recognised by the Viceroy who has presented three pedigree bulls for the improvement of cattle in villages in the vicinity of Delhi. If, as the Viceroy hopes, his example is taken up by men of affluence all over the country there is no doubt that considerable improvement in the livestock of the country will be the result.

In Madras in addition to sale of pedigree bulls from Government farms, private enterprise has been encouraged since some years by the offer of a premium towards the maintenance of breeding bulls. The results of this work have probably not become so apparent yet, as the number of such bulls forms only infinitesimal proportion of the requirements. We are glad that men of position in some of the districts Coimbatore, Tanjore, etc. have come forward to copy the excellent example of the Viceroy. We believe however that the difficulty for a great expansion of this work will be the dearth of a suitable number of bulls of known pedigree. The supply from Government Livestock stations would not be enough and the question of suitably subsidising private enterprise in the direction might have to be considered.

Adulteration of Food Stuffs. The Public Health Department have recently circularised all the local bodies about the importance of the supply of pure food stuffs and drawing their attention to the necessity of extending the provisions of the Madras Prevention of Adulteration Act to all local areas where it is not already in force. This act of 1918 has been until recently in force only in a few of the major municipalities but has since been extended to practically every municipality in Madras. The working of the Act has shown that the adulteration of food stuffs is being carried out on a large scale and statistics, it appears, have shown that in some places over sixty percent of the samples purchased for analysis is adulterated.

The circular gives details of the scope of the Act in respect to some articles of food as milk, butter and ghee, oil, coffee, tea, etc. In spite of the recognition of the importance of milk as a source of food, it is the one substance most commonly adulterated. The addition of water to the milk not only robs children and invalids of an essential nourishment but sometimes the water added carries with it germs of serious diseases. Similarly butter and ghee are often adulterated with other fats both animal and vegetable.

Unlike in the case of milk and butter, the adulteration in vegetable oils such as gingelly, groundnut, coconut is not probably serious as the food value is not apparently affected. The question is simply one of adulterating an expensive sort with a cheaper kind and the adulterant may vary from district to district. The necessary sectional help to analyse samples is proposed to be given to local bodies by Government in return for a small animal contribution. We do hope that every local body, as the custodian of the health of the people in its area will see that the Act is brought into force if it has not been done already.

In addition to the adulteration mentioned above, there is quite a different kind of adulteration often practised in case of food grains.

In rice for instance, old rice and long duration rices fetch a better price but it is becoming usual in trade to adulterate the old with fresh rices and the long duration (*samba*) with the early duration (*kārs*). Such adulteration is rather difficult to make out. Unlike in the case of milk, butter and ghee it is rather a difficult proposition to fix standards in the case of food grains but we believe the question is bound to assume importance in course of time.

Rao Bahadur T. S. Venkataraman and the Indian Science Congress. We are glad to learn that Rao Bahadur T. S. Venkataraman, Government Sugarcane Expert has been chosen for the honour of presiding over the 24th session of the Congress in January 1937 at Hyderabad. The Sugarcane work in Coimbatore, though initiated by the late Dr. Barber, has been so ably carried out by T. S. Venkataraman during the last 16 years and more that it has become to be well known all over the sugarcane world. If we wish to give instances where the work of the plant breeder has resulted in enormous benefit to the country and to the cultivators, the sugarcane work at Coimbatore will always stand out as the most striking one.

This is the second time since the Congress was founded that a member of the agricultural service has been chosen as the general president of the Congress, Sir A. Howard having been the President of the Congress in 1926. We offer our very hearty congratulations to Rao Bahadur T. S. Venkataraman on the unique honour bestowed on him.

PINE APPLE CULTIVATION IN THE *MODAN* LANDS OF MALABAR.

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Introduction. Though the soil and climatic conditions obtained in Malabar are ideal for the cultivation of pine apples even on the proverbially poor *modan* lands, yet its cultivation was until recently, confined to a few isolated plants of the local wild variety along the fences of house compounds. The introduction of the Kew and the West Indian variety of pine apple a few years back through the Agricultural Departments of Madras and Cochin State, coupled with the demonstration of the profitableness of its cultivation has given a fillip to the growing of this valuable fruit crop on a plantation scale throughout the West Coast. The cultivation of Kew pine was taken up in 1930 as an alternate crop for paddy in the *modan* land area of the Agricultural Research Station, Pattambi. Encouraged by the success of the first plantation on the station, a comprehensive study of the crop in all its bearings is in progress. Some of the useful observations made during the six years of its cultivation on this station are embodied in this article.

Varieties. There appears to be no definite varietal classification in pine apple. The same varieties are often known by different names in different places. A close study of the collection of all the varieties obtainable in India discloses three broad groups : (1) *Kew* or *Giant Kew*, Spineless or smooth Cayenne, Sarawak, Mexican White etc. This is the best of the fancy pine apples. Leaves have ordinarily a few spines on the margin near the tip and base, although they may be occasionally absent. (ii) *Mauritius* is similar to spiny Spanish or Queen, Joldopi, Ghaspani etc. This is much smaller than the smooth Cayenne, the weight of the fruits ranging from 2-4 lb. Plants are small and the leaves coarsely serrated. (iii) *Wild*—This is identical with the Simhachalam, the local, or the Deshi variety.

Propagation. Most of the improved varieties seldom set seed, though some are said to produce seed. Propagation is generally from suckers which are of different kinds. Those that spring from the base of the mother plant below the soil level are generally known as ' ratoons ' and those that arise from the axils of leaves above ground level out of contact with soil, are called suckers. Besides these two classes, there are crowns at the top of the fruit and ' crown slips ' at

the base of the crowns, and 'slips' originating from the base of the fruit. All the different kinds of propagating material referred to above are common in the case of the indigenous wild varieties. Ratoons, crowns and suckers are the most common in Kew and Mauritius, while slips are absent or almost so. Ratoons in Kew normally appear only after the harvest of the fruit, while in the case of the Mauritius group suckers grow with the mother plant even before the formation of fruits.

All these planting materials do form fruits when propagated, yet the time taken for the formation of fruits varies with the nature of materials planted. Observations on flowering in crops obtained from different types of planting material. have shown that aged suckers form the first fruits twelve months after planting 16 per cent of the plants planted putting forth heads in 16 months, and 82·6 percent at the end of 30 months. In crops raised from crowns and young ratoons (size similar to crowns) however the first fruit was formed only 25 months after planting and 58·1 % and 38·7 % respectively of these plants blossomed at the end of 30 months. It is therefore clear that fairly uniform suckers of sufficient age (4–6 months) that have grown with the mother plant are ideal for planting, the harvests in them commencing 15 months after planting. If the suckers are too aged when planted, small sized fruits are formed prematurely.

Planting. Planting can be done in diverse ways, in trenches (most commonly adopted) or in shallow pits. Until recently, trenches were dug 4′ apart, 1½′ to 2′ deep and suckers planted in them 3′ apart. As the crop is to be left in the same plot for five or six years, trench planting appears to be convenient as it allows periodical earthing up ot the subsequent ratoons. Pine apple plants develop a shallow roof system spreading laterally to about 9 to 12 inches and the roots are closely matted round the stem.

The plots intended for planting are to be thoroughly prepared beforehand and trenches dug about a month prior to planting, to allow the soil so dug out to weather. It will be even advantageous, if the trenches are burnt with rubbish and the surface soil filled up. Experiments are under way to find out the exact manurial requirements of the crop. The most economic method of planting is to open trenches 2′ wide and 4′ apart and plant 2 rows in each trench, the plants spaced 2′ apart. The results of the preliminary experiment on depth of planting conducted with the Mauritius variety, (Table II), point out that shallow planting (1′ and 6″) induces early fruiting as compared to greater depths of 1½′ to 2′. Over 60 per cent. of the plants of the shallow planted group produce fruits between the first 12 to 20 months as compared to about 20 per cent only among the deeply planted group. Rate of planting in different countries varies with the market requirements. Closer planting is adopted if the fruits are intended

for canning purposes. In cases where there is a demand for good sized fruits, wider spacing would seem necessary. 4,000 to 5,000 suckers per acre would be the optimum, though in certain pine apple growing countries even 10,000 are said to be planted per acre.

Planting Season Pine apple plantation is generally started with the onset of the south-west monsoon rains in June–July, though it can be deferred to the north-east monsoon period also, the only point to be borne in mind being the presence of adequate amount of moisture in the soil for the plants to establish. Successful crops have been raised during both the seasons at the Agricultural Research Station, Pattambi. The advantage of planting in the north-east monsoon is that a green manure crop can be grown during the south-west monsoon and suckers of sufficient growth would be available which can produce fruits in the next year after planting. Further, the adoption of both systems of planting would help to widen the period of harvest in a farm.

After-care. Once the crop is established, it requires very little attention excepting early incorporation of manures and clean diggings, weed control being the chief consideration in the latter.

Harvest. The harvest largely depends on the kind of planting material, season of planting, soil, fertilisers etc. Suckers and ratoons of optimum size (4–6 months) produce fruits within 16 to 18 months, crowns take longer time from 24 to 28 months according to the diverse factors affecting the growth of the plant. The frequency of flowering of a first crop planted in June 1933 is set out in Table III (a). It will be seen from the table that the first fruiting commences 12 months after planting and is completed by about 30 months. The interval between the appearance of the head and the maturation of the fruit varies slightly with the season of harvest, (Table IV a). The post-monsoon harvest (October batch) takes about two weeks less than that of the monsoon batch (June—July). This is evidently due to the heavy monsoon rains and a reduced period of sunshine in June—July which probably retards the ripening process. Harvesting should be done at the right stage lest the flavour should be affected. As the fruits ripen, the 'eyes' or 'pips' flatten, the margins round up, and the space between the eyes wilt and shrivel and the bottom and the centre of the eyes turn yellow.

A too luxuriant growth of the crown is a disadvantage. While harvesting, the fruit stalk should be cut with a sharp knife and any amount of care bestowed in handling the fruit from the harvest until it reaches the consumer, is not wasted, since even slight abrasions are likely to cause a rapid decay of the fruits. The pulp of the Kew fruit is very juicy and the fruits display a great tendency to bleed their juices with the slightest knock or wound.

Yield. Yield varies widely and is dependent on several factors. With closer planting and use of better planting material the average yield can go up to even 20 tons per acre. From the figures available so far the following inferences can be drawn.

(i) There are two main periods of fruiting, the first period from April to July and the second or late crop from October to January though a few fruits may also be available during other periods.

(ii) The size of the Kew fruits go up to 18 lb. and more, under adequate manuring and favourable seasonal conditions.

(iii) The average weight of July harvested fruits is the lowest ranging from 2·4 to 5·2 lb. per fruit wherever the October batch gives the highest average ranging from 7·2 to 9·1 lb. (Fig 1). This may be due to the fact that the June—July fruits flower and grow during the hot rainless months of March – April, while the October batch gets the beneficial effects of the south-west monsoon.

(iv) A crop once planted can be kept for 4 to 5 years. Maintaining the crop longer, say 6 or more years, very much reduces the size of the fruits. The average weight of a fruit goes down from 9 to 3·7 lb. as the plantation gets older.

Economics. Pine apple cultivation in the *modan* lands of Malabar has been proved to be a practical and profitable proposition from the figures given in Table V. Usually such types of lands are of a non-remunerative type. Since the soils are very poor, cultivation is done only once in 4 or 5 years. The net return from an area for a three-year period under the normal cropping practised on such soils at the Agricultural Research Station, Pattambi, would be about Rs. 48—8—0 or Rs. 16 per year. The same area if devoted to pine apple cultivation would give in the corresponding period a profit of Rs. 334—12—0 per acre or Rs. 112 per year, (Table VI).

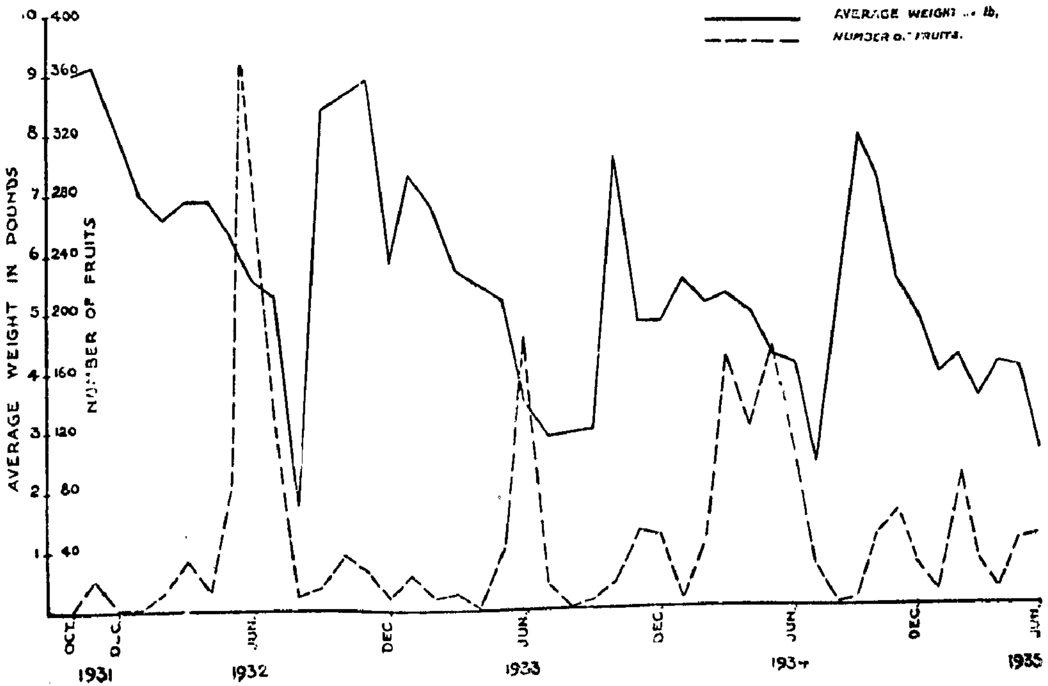
Pests and Diseases. (a) Jackals, certain canine species and rodents are the only major enemies of this crop noted so far in Malabar. If proper protection is not provided, 25 to 40% of the fruits are likely to be damaged by such animals. A bamboo basket has been improvised to encase each plant just a fortnight before the ripening of the fruit and this has to a very considerable extent diminished the losses. The cost of the basket is only an anna, which if properly preserved may last for two to three seasons.

So far no fungus disease has been noted on the crop. A certain amount of rotting of the central core in newly planted plants is sometimes observed, which in all probability might be due to mechanical injury.

(b) *Sun burn.* When the fruits are directly exposed to sun's rays, injury of a more or less severe type takes place on account of the

GRAPH SHOWING THE AVERAGE WEIGHT OF A KEW FRUIT AND THE TOTAL NUMBER OF KEW FRUITS HARVESTED DURING DIFFERENT MONTHS FROM 1931-1935

A. R. S. PATTAMBI.



scalding and destruction of the internal tissue. Tying up the top wharls of leaves on the fruits mitigates this evil to a large extent.

(c) When the planting material is too small sand or soil sometimes fills up the heart of the newly planted suckers and causes decay. Selecting fairly good suckers of optimum size is bound to lessen this trouble to a great extent.

(d) *Malformations.* It occasionally happens that in the Kew varieties the inflorescence completely proliferates and no fruits are formed. Whether cause of such proliferation is physiological or pathological has to be ascertained. It is surmised that it may be a provision made by nature for propagating its own species by producing numerous plantlets as the Kew variety has been found to be usually shy in producing suckers.

Table I.

Frequency of flowering and harvest of Kew Ratoons, young and old and crowns.

Planted on 14—7—1933.

No. planted.

Young	...	62
Old	...	172
Crowns	...	31

Year	Old ratoons		Young ratoons		Crowns	
	No. flowered	No. harvested	No. flowered	No. harvested	No. flowered	No. harvested
Total for 1934	28	21	—	—	—	—
% "	16·3	12·2				
Total for 1935	114	77	24	11	18	8
% "	82·6	44·8	38·7	17·7	58·0	25·8

Table II.

Table showing the effect of depth of planting on the flowering and harvest of Mauritius pine apple.

Planted on 14—7—1933. No. of suckers planted—27.

Year	Six inches		One foot		One foot six inches		Two feet	
	Flowd.	Harvd.	Flowd.	Harvd.	Flowd.	Harvd.	Flowd.	Harvd.
% for 1934	66·7	51·9	6·3	51·9	22·2	18·5	18·5	18·5
% for 1935	100·0	100·0	100·0	100·0	100·0	100·0	100·0	92·6

Table III (a).

Periodicity of flowering in kew suckers of fairly uniform size.

Planted on 17—6—33. Area 14·22 cents. No. of suckers—489.

Years	Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total	% flowd.
1934	—	—	—	—	1	—	26	81	20	80	22	—	230	47%
1935	49	14	4	—	3	5	1	93	12	23	36	10	250	98·2%
1936	9	—	—	—	—	—	—	—	—	—	—	—	—	100%

Table III (b).

Flowering of kew suckers when planted in October.

Planted 23 & 24—10--1934. Total suckers planted—653.

	January.	February.
1936	185	15
%	28·6	30·6

Table IV (a).

Table showing the period taken for ripening of kew apples from the appearance of the 'head'.

Range in days.	May—July.	October—November.	Dec.--January.
95—105	—	9	6
106—115	10	38	17
116—125	35	4	7
126—135	9	—	4
Total ...	54	51	34

Table IV (b).

Periodicity of harvest of 'kew fruits .

Planted on 17—6—33. 489 suckers planted.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total	%
1934	—	—	—	—	—	—	—	—	1	19	70	35	125	25·6
1935	19	82	7	1	37	25	3	1	1	2	38	54	270	80·8
1936	14	14	38	—	—	—	—	—	—	—	—	—	—	—

Table V.

Economics of the cost of cultivation in an area planted in 1933.

Area : 14·22 cents. No. planted per acre : 3425

No. of suckers planted : 489 Planted on 16 & 17—6—1933

Expenditure.	*1933—35.*	*1935—36.*
Preparatory cultivation ...	11—6—3	
Suckers and planting ...	22—1—6	
Manures and manuring ...	8-14—6	3—1—6
After cultivation ...	10—9—9	2--8—0
Proportionate cost for baskets ...	—	3-14-6
Proportionate expenses for putting wire fencing	6--0—0	6—0—0
	59—0—0	15—8-0

Receipts.

1933—35.	197 fruits weighing 1235½ lb. at 9 pies per lb.	57—14—8
1933—35.	Suckers	--
1935—36.	205 fruits weighing 1084 lb.	50—13—0
1935—36.	512 suckers at Rs. 4 per 100	20— 8—0
		129— 3—8
Total Receipts		129— 3—8
Total Expenditure		74— 8—0
		54—11—8
* Profit per acre		383—4—0

* 59 fruits were damaged by rats, bandicoots, toddy cats etc., and this would have fetched an additional profit of Rs. 16 per plot and Rs. 112 per acre.

Table VI.

Economics of the modan land cultivation as ordinarily practised, rotated at the Agricultural Research Station, Pattambi.

(Estimated Cost).

Year.	Rotation adopted.	Cost of cultivation.	Value of produce.	Net profit.
1933-34	Modan Paddy	16—8—0	27—0—0	10—8—0
„	Gingelly	15—4—0	25—0—0	9-12—0
1934-35	Samai	8—0—0	13—0—0	5—0—0
„	Horsegram	4—0—0	7—0—0	3—0—0
1935-36	Modan paddy	16—8—0	27—0—0	10—8—0
„	Gingelly	15—4—0	25—0—0	9-12—0
	Total.	75—8—0	124—0—0	48—8—0

Profit when pine apple is grown ...	Rs.	383—4—0
Profit when other crops are grown ...	„	48—8—0
Extra profit when pine apple is grown	„	334-12—0

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ON SOME CONTROL EXPERIMENTS ON THE DECCAN GRASSHOPPER (*Colemania sphenarioides*, B).

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This paper deals with certain experiments carried out by the author in 1930 and 1931 in Adoni, Bellary. It is considered, a history of the pest for the past thirty years and a resume of the work done till now, will be a useful and fitting introduction for the problem dealt with in this paper and hence a brief introduction has been added.

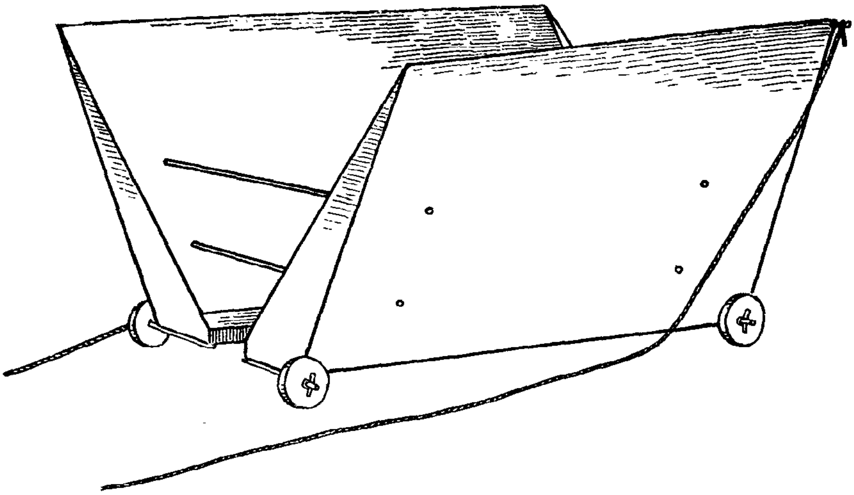
As for the systematic position of the grasshopper, it comes under the tribe *Pyrgomorphini* and is placed very near *Orthacris* which it very closely resembles. The pest would appear to be indigenous to Bombay Presidency, being chiefly confined to the Belgaum, Bijapur and Dharwar tracts; from thence they would appear to have spread south into Mysore, Hyderabad and Madras territories.

The zone of distribution for Madras would seem to centre round the Tungabhadra valley in Bellary and Kurnool districts. Adoni, Kudligi, Harpanahalli, Hadagalli, Siruguppa taluks of Bellary and Markapur, Kurnool, Pattikonda taluks of Kurnool, are the chief centres wherein the pest has been noted in a severe form, off and on. The hopper was first noted in a pest form in 1908; for nine years thereafter it proved very destructive. Subsequently, from 1917 the incidence became negligible. After an interval of nearly eight years the pest was again found to be on the increase from 1925 and continued to be so till 1931, when a slight subsidence was noted. Thus paucity and abundance would appear to move rhythmically in cycles of seven years.

The grasshopper is mainly a pest on dry cereals and attacks them in all stages from emergence of leaves up to the setting of grains. Damage to crop varies with the nature of the incidence, the loss being total when infestation is severe. More information especially on the life history details, mode of infestation of new tracts, etc., is given by Coleman (1911) in the Mysore Agricultural Departmental Bulletin No. 2 (Entomology) and by Ramachandra Rao in the Madras Agricultural Departmental leaflet No. 39.

Control measures that were tried are dealt with in detail. Bagging was found very efficient for Mysore conditions. But, for conditions obtaining at Adoni, where very stiff and severe winds are the feature in August and September, it is not a feasible proposition to try bagging. Nevertheless, trials were made and for the reasons mentioned below they never proved a success. Firstly, it is a strenuous and tiring job even for three men to go on the run with the bag ballooning against the wind. Secondly, it has been found by actual trials that nymphs were not in a mood to be dislodged easily when high winds prevailed with the result the catches were seldom large for the population of nymphs and for the time and labour spent on the operation. Therefore, bagging as a control measure was given up and other methods were put to test. The results obtained at these tests are embodied in this short paper.

Trials. (a) *Guntaka hoeing for destruction of eggmasses in the field.* It was suggested that the then newly designed H. M. Guntaka (Hilson and Munro) might prove an efficacious weapon for destroying the eggmasses in the soils of the field. Therefore, trials were undertaken with this implement. A field that was infested rather badly, the previous season, with hopper adults and with a high density of eggmasses, was selected for trials at Adoni in 1930; the actual operation was done in January 1930 under the supervision of Mr. C. V. Sundaram, then, in charge of the work. The object of this trial was to cut out the eggmasses laid in the soil and expose them to the weather and the dessicating action of the sun which is exceptionally severe from March



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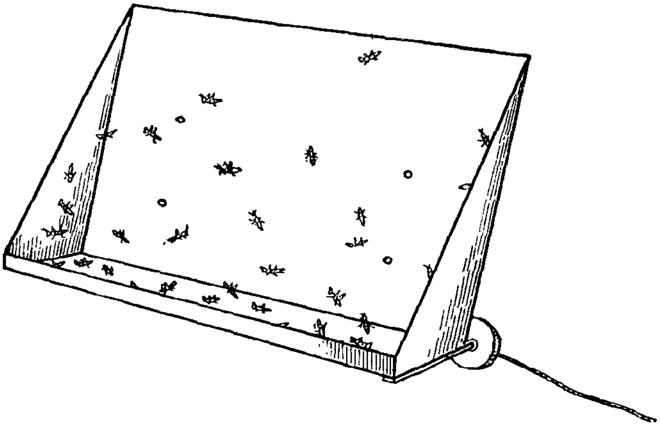

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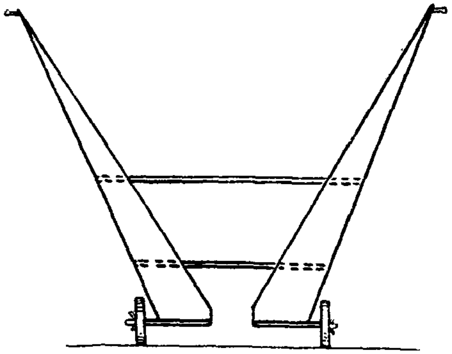

(3)

(1) Hopper dozer—Full view.

(2) Hopper dozer—Inside view showing catches.

(3) Hopper dozer—Front view.

to May. Subsequently, the ryot carried out the preliminary cultivation operations with country plough and *Pedda guntaka* in July. The field was sown to '*Korra*' *Setaria* (Tenai) in the last week of July. The hopper nymphs did not hatch out till the beginning of the 2nd week of August. The adjacent field was taken as the control. The difference in density of hopper nymphs in the unworked and worked fields should be the basis on which to judge the efficacy of '*Guntaka* hoeing' on the destruction of eggmasses. For this, a small tin box with a clearance in the centre was run through the lines on 16th August, a week after emergence and the nymphs that hopped out on either side were caught by the side walls, the inner side of which was painted with a resinous adhesive. The nymphs so caught were immediately counted for each row operated; similarly for the control rows. Discarding the few that escaped from the treated and untreated areas, the counts gave an average population of 27 nymphs for the treated and 15 for the untreated rows. Judged on the basis of these catches one should feel that '*Guntaka* working' had not produced the results anticipated of it and had not given encouraging results to deserve further trials.

(b) *Trapping with hopper dozers.* Therefore, the feasibility of trapping the young nymphs was next considered. Since the crops in Bellary are sown in drills, the idea of running a well designed hopper dozer along the lines seemed promising. The idea was not new. Mr. Ramachandra Rao had tried an ingenious method in 1911 to entrap the nymphs by running several flat boards joined together and painted with tar to serve as an adhesive. But the thing proved cumbersome and was not pursued further.

A hopper trap to operate for a single line, at a time, was designed by Mr. Charley, the Research Engineer, on the basis of suggestions given to him by the author. It was got up in time for trials in 1931 against the hopper nymphs. The hopper cart weighed about 80 lbs. and was mounted on two iron wheels; it was to be pushed from behind by a single person with the aid of the arms. The crop was to be passed through the central clearance and cross bars were provided to shake and jerk the hoppers into the bottom pans which were painted with the resinous adhesive. But, unfortunately, the dead weight of the cart proved too heavy for a single man to operate, especially in these soils where considerable resistance was encountered owing to wheels sinking into the soil. So, bullock power was substituted instead and tried in different villages on 13th August 1931. For 20 lines of *Korra* crop 6 to 9 inches high, 450 nymphs were secured but the difficulty of manoeuvring the trap with bullock power was great as the trap wobbled and sometimes ran over the crop.

Since the principle was acceptable to the ryots and showed some promise, a light tin cart model was made, on the same principle,

weighing not more than 20 lbs.; it was mounted on four wheels, two in front and two behind. The diagrammatic sketch of the model is separately shown so that one could get an idea of the trap. It was to be run through the rows of crops which were allowed to pass through the central clearance provided at the bottom of the trap. The two bottom pans of 5·5" wide on either side of the clearance into which the nymphs usually hopped, were painted with the resinous adhesive. This served to fix them and keep them from straying out. Similarly, the side walls were painted. The trap measured 46" along its length and 36" in height from the surface level. Just as in the previous model, cross bars were provided to jerk the hoppers and to give firmness to the side walls and prevent them from sagging.

Working of the trap. The trap was to be dragged in from front by a couple of boys, by holding the ropes fastened to the rear. The boys were to pass along the adjacent lines of 'Korra', to avoid disturbing the hopper nymphs in the lines that were to be worked. As soon as the bottom pans and the sides got filled up, the resin was scraped off with the nymphs and a second coating was given. The adhesive was kept ready in a mud pot kept warm by paddy husk fire in a mud basin.

Trials. Extensive trials were given in the field of one Narasappa in August 1931. In the initial trials 198 nymphs were secured for 15 lines of 200 yards length despite the fact that a good many escaped slowly owing to the adhesive losing its adhesiveness on account of high winds. But this defect was subsequently corrected by addition of more of oil in the preparation of the adhesive to counterbalance evaporation and drying. At subsequent trials 238 nymphs were secured for 14 lines, 355 for another 14 lines. But when the winds abated a little, the catches mounted upto 709 in the morning and 635 in the evening for 20 lines. The average per line increased from 13 to 33·5 when the winds abated. This only indicates how winds tend to hamper the control operations of this kind. Further trappings gave 712, 718, 698 nymphs for 20 lines each, on different dates. The lines once operated were never again touched. In all 4344 nymphs were captured, of which 3473 represented catches for 100 lines of 1·5 acres.

Estimation of the residuals and the incidence of hopper nymphs per acre. Unless it was exactly known how many were actually left behind, it will not be possible to arrive at a correct estimate of the incidence of the pest. Moreover, without an idea of the residual population it will not be possible to judge whether a control method was promising or not. If the residual out-numbered the catches it would speak very poorly of the method. Hence the residual population was determined separately for each row. For this the trap was run forward on the first run; the nymphs so caught were immediately counted; the trap was reversed on the 2nd run and the number caught in the reverse run would give the residual population for that

line. In the first run 30 nymphs were secured; in the reverse run 12 more were secured; of these, a few might represent the immigrants from the adjacent line to which the persons have to keep close when dragging the trap in front. Several such trials indicated that roughly 75% population was easily secured in the first run itself.

A rough estimate of the severity of infection is certainly possible by multiplying the average population per line by the total lines in the field. On this basis, Narasappa's field of 4 acres containing 285 lines would give approximately a population of 10,000 nymphs. An occurrence of 2500 nymphs per acre, then, should be considered as a case of severe infestation, knowing full well how badly the crop was attacked.

Economics of working the trap. From a series of trials, it was computed that the trap could easily cover 20 lines per hour, at this rate a four acre field of 285 lines could be covered in two days. A ryot usually works from 6 a. m. to 1 p. m. in the Ceded Districts and does not work in the afternoons. He puts in 7 hours at a stretch and on this basis it should be possible to finish the 4 acre plot in two days.

Labour charges come to about a rupee for two days for two men but no ryot actually incurs this expenditure as his own family takes to the work.

The cost of adhesive comes to about 6 annas per acre as per the details—2 annas for the groundnut oil; 3 annas for resin; ½ anna for fire and ½ anna for mud pot. The adhesive was prepared in the ratio of 1:2 of oil and resin, by weight. The expenditure on the trap todate including all improvements comes to Rs. 5/— including the cost of a painter's brush; the trap could be used over and over again for a minimum of four seasons as not much is lost in the wear and tear.

Future of trapping as a method in the control of nymphs in the Ceded Districts. There is little doubt that trapping of this kind may have good future for the following reasons. It obviates the killing since the nymphs on the adhesive die a slow death and the general prejudice of the ryots against killing is overcome. Being light, handy and efficient, it is easy to operate. Boys can manage it and adults may attend to hardier work. No subsequent trapping is necessary as a high percentage of population is secured in the first run itself. The trap is durable and will serve for a minimum of four seasons for a small holder. Well organised demonstrations may be necessary for the ryot to get to know the utility of this method.

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AGRICULTURE IN ANCIENT GREECE

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What we know of ancient Greece relates more to its political institutions, its arts, its architecture, its literature, its history, its philosophy, etc., but very little about its agriculture. This is because the ideas concerning the rural life in ancient Greece are dispersed in a few fragments of its literature, particularly in its pastorals. About eight decades ago, Mr. St. John's *History of the Manners and Customs of Ancient Greece* was published in which the author had collected all that could possibly be known on the subject. Based on this work, a lengthy account of the "Rural Life in Greece" was given in No. 34 of "Chambers's Repository" published in the fifties of the last century. The material for the following account of agriculture in ancient Greece has been taken from the latter publication.

In olden days the mountains and hills of Greece were clothed richly with wood and as a result of this there were numerous streams and brooks by which the land became fertile. The fields were generally separated from each other by hedgerows; from farm to farm there were small pathways with rustic stiles and seats at intervals to assist women of the different farms to visit each other and between the several estates ran small roads or green lanes generally shaded with trees.

In the earlier ages, no doubt, varieties of cultivation and the animals bred were few but as civilisation advanced, "the arts of the husbandmen were multiplied and refined, new breeds of animals were introduced; the economy of the farmyard became more complicated; the introduction of one new fruit followed that of another; gardens were constructed, partly for profit, partly for pleasure; and all the beautiful varieties of trees, shrubs and flowers, known to the climate, were planted for use or luxury".

It was common to erect farmhouses in the midst of plantations of silver-fir, which in winter gave protection from cold, and in summer attracted breeze. Towards the centre of the grove, with a spacious court in front, and a garden behind, stood the house, sometimes with flat and sometimes with pointed roof. There were numerous outhouses, such as the stables, sheds for cattle, hen-roosts, pigsties, etc. which extended round the court, while the back-front opened upon the garden or the orchard. Great care was taken in selecting the site of the farmhouse. The houses were generally large and roomy.

The breeding of birds was considered very important; geese, ducks, pigeons, peacocks, pheasants, partridges and the common

barnyard fowl were bred on most farms besides goats, pigs and dogs. Sheep and cattle commanded a large share of attention. Horses were not numerous in Greece and they were not employed in agriculture but were used chiefly for military purposes, for religious pomps and processions and for chariot races at Olympia. The mule and the ass were much used. The oxen were useful in ploughing, treading out the corn, drawing manure to the fields and bringing the produce home, although mules were also sometimes used at the cart and the plough. The milch-cows were generally fed on cytisus and clover. The milking time was usually in the morning, immediately after the peep of dawn and in the evening, just when the twilight closed; though occasionally cows, sheep and goats were milked several times in the course of a day. Butter was little used but of cheese many varieties were manufactured. The milkwomen, churners, and cheese makers were adepts in all the arts of their profession. To detect the presence of water in the milk they used to dip a pointed reed into the milk, and if the milk ran off easily, it had been diluted, or if a few drops of the milk were poured on thumb-nail, that which was pure would remain there while the adulterated milk would speedily make its escape.

Bee-keeping was one of the important employments of the farmers. Owing to the climate and soil, bees throve better and produced more honey than in many other parts of the world. In the Homeric age bees had not been accomodated with hives but were forced to search for their own dwellings in hollow rocks. In course of time, many persons devoted even their whole lives to studying the natural history of the bee, "living alone in sequestered spots, where, at their ease, they might watch its habits, observe it busy through 'the shining hours' enjoy the delicious taste of its honey, and breathe with this the rich fragrance of the flowers on which it loves to feed".

The bee-keeper who tended the insect for profit devoted great care and attention. "In a sheltered spot, generally on the slope of hill, covered by thyme, the hives were arranged in the midst of flowers, delicate plants and odoriferous shrubs; and if nature had not scattered there the necessary kinds, the gardener planted and cultivated them. Experience soon taught them what blossoms yielded the best honey and were most agreeable to the bees. These, in Attica, were supposed to be the wild pear tree, the bean, the clover, a pale coloured vetch, the Syrian myrtle, wild poppy, wild thyme, and almond tree. To these may be added the rose, balm-gentle, the galingale or odoriferous rush, the basil-royal, and above all the cytisus, which begins to flower at the vernal equinox and blooms until the end of September. Of all the plants, however, affected by the bees, none is so grateful as is the thyme, which, in Attica and Messinia, so extensively abounds as to perfume the whole atmoshere. × × × × Great care was taken to conduct near the assemblage of hives small runnels of the purest

water, not exceeding two or three inches in depth, with shells and pebbles just rising dry above the surface, whereon the bees might alight to drink. When, of necessity, the apiary was situated in the margin of a large stream or lake, other contrivances were resorted to for the convenience and safety of the airy labourers. × × × × The hives were of various kinds, some made of the supple bark of trees, others of hollow trunks; while there was one sort constructed with *Lapis secularis* which being almost as transparent as glass, enabled the curious owner to contemplate the movement and work of the bees".

The cultivation of flowers and shrubs of delicate foliage was widely practised because these were being constantly required for forming garlands, crowns and wreaths made use of by the Greeks on innumerable occasions. "When they offered sacrifice to the Gods, when they were present at the Olympian, Isthmian, or Nemean games, when they went to the theatre, when they attended at the banquets or when they visited their mistresses their heads were habitually crowned with flowers. These also were piled on altars and the doors of temples; and frequently the whole front of the houses of the women they loved appeared like one blaze of garlands. For this reason the cultivation of flowers was as much attended to in most parts of Greece as that of fruit trees or the vegetables most commonly in use". "They were worn at some of the ceremonies attending the birth of infants, many of the games of youth, during courtship, marriages, and at every religious festival and private banquet or public procession. And lastly, the corpse, before being placed in the coffin, was crowned with a chaplet; garlands and ever-lastings were laid on the tomb, mourners, when they came to visit the grave, wore wreaths of flowers upon their brows. This taste is still prevalent in Greece; and on May-day every door in Athens is decorated with a garland".

As will be seen from the following extracts several flower plants and herbs were known to the Greeks and were cultivated.

"Copses of *Agnus castus*, roses myrtles, and other sweet-smelling shrubs, intermingled with a pomegranate tree in the midst, were usually planted on elevated spots, that being thus exposed to the winds, they might the more freely diffuse their fragrance. The spaces between these masses of foliage, were sometimes filled with roses and lilies, and violets and golden crocuses, and sometimes presented a breadth of smooth close green-sward, sprinkled with flowers, such as the violet, the blue veronica, the pink and the pale primroses, the golden mother-wort, the cowslip, the daisy, the pimpernel and the periwinkle".

"Bowers and arbours were often formed entirely of myrtles. Occasionally these were intertwisted with the honeysuckle, the eglantine, the jasmine, and the broad-leaved philyrea, whose yellow tufts

mingling with jasmine and myrtle constituted one of the most graceful adornments of the Greek gardens. Thickets composed of other beautiful shrubs, lay between the bowers and the copses, the flower beds, and the turfy slopes, with those loftier piles of verdure consisting of the pine-tress, the smilax, the cedar, the carob, the maple, the ash, the elm-tree, the platane, and the ever-green oak, which here and there waved their stately foliage over the ground ".

" A netting of wild thyme, tufted with sweet mint and marjoram which, when crushed by the foot, yielded the most delicious fragrance was spread over the stony hillocks; while here and there, singly or in beds, grew a multitude of other herbs and flowers, some prized for their medicinal virtues, others for their beautiful colour, others for their delicate odours—as the geranium, the spike-lavender, the rosemary, with its white and purple flowers, the basil, the flower-gentle, the hyssop, the white privet, the cytisus, the sweet-marjoram, the rose-campion or columbine, the yellow amaryllis and the celandine".

Besides roses, lotus and lily, the pansy, the purple cyperos, the iris, the water-mint, the hyacinth, the narcissus, the willow-herb, the blue speedwell, the marsh marigold, or brave bassinet and the jacinths and early daffodil also flowered profusely.

There were also some other plants of minor importance. A very considerable trade was carried on in herbs and plants which were exported to all the countries lying on the shores of the Mediterranean.

The gathering, drying and preserving of medicinal herbs and roots which required much study and toil, were done by professional herbalists who travelled, at the proper seasons of the year, through mountainous provinces etc.

The orchard, which lay beyond the garden, was usually surrounded by close hedges of black and white thorn, and sometimes by rows of olives. The trees were numerous, the following being the more important:—the apple, the pear, the cherry, the plum, the quince, the apricot, the peach, the nectarine, the walnut, the chestnut, the filbert, the hazel-nut, the medlar, the mulberry, the fig-white, purple and red, the pomegranate, the orange, the citron and the lime, the date-palm, the pistachio, the almond and the cornel tree.

Many vegetables were grown—the radishes, turnips, asparagus, broccoli, garlic, peas, beans, gourds, cucumbers, and lentils being the more important.

The fruits, vegetables and flowers were taken to the market for sale. The space allotted for the sale of agricultural produce was in most cities very considerable. There were fruit booths, green-grocers' stalls, stands for flower-sellers, etc.

The cultivation of vine was one of the ordinary occupations of life among the Greek farmers. They knew what soils would produce

the best vine and enable them to make the most money. In this branch of industry they displayed great intelligence and skill.

After selecting the soil it was enclosed with a hedge sufficiently thick and strong to keep out goats and foxes which loved to prey upon the vine. The next thing was to grub up the hazel-bush and the oleaster, after which the ground was trenched and thrown into lofty ridges, which by the operation of the summer sun and the rains and winds and the frosts of winter, were rendered mellow and genial. Occasionally a species of manure of pounded acorns, lentils and other vegetable substances was dug in, for the purpose of giving the soil that warmth and fertility required to nourish the vine. After the ground remained in this state for a whole year, its surface was levelled and a series of shallow furrows traced for the slips to be planted.

There were three kinds of vine, *first*, that which was supported on short props, *second*, the vine which climbed over trees, and *third*, that which being planted in stony places, on mounds or on the steep sides of hills, was suffered to spread over the ground and to ripen the grapes in that situation.

Stout reeds were used as props and when reeds were not obtainable ash props were substituted, having been first carefully barked and smeared at top with pitch, to prevent their being decayed by rain. The vines in rich lands were allowed to attain a height of six feet while in the case of lighter soils and on the slopes of hills they were allowed to reach only three feet.

The trees commonly used for training the vines were the black poplar, the ash, the maple, the elm, and probably also platane. These were planted in straight lines and rising behind each other, terrace above terrace, at intervals of 23 or 24 feet. The face of the trees along which the vine climbed was cut down smooth like a wall against which the purple or golden clusters hung thickly suspended; while the young branches crept along the boughs or over bridges of reeds, uniting tree with tree. The lower boughs of the trees were, however, carefully lopped off. Winding of the vine round the trunk of the tree was carefully avoided by inserting wooden wedges here and there between the stem and the tree. The space between the trees was ploughed and sown with beans, gourds, cucumbers and lentils. Sometimes the ground was used for growing pomegranate, olive, quince and apple.

While the grapes were growing they were shaded by a thick crop of leaves; but as soon as they began to turn colour the leaves, which of themselves then shrivelled, were carefully stripped off, to allow the full force of the sun's rays to pour upon the fruit and hasten the ripening. Such clusters that ripened before others were cut off.

The season for vintage operations was determined by law and only when the magistrate declared that the season of vintage was come,

the operations were started. The vintage season was one of boisterous and frolicsome mirth to those engaged in the several operations.

Immediately after the vintage, the country-people turned their attention to the gathering of the olives and the making of oil, which constituted an important branch of their husbandry. Both the oil and the olives themselves formed important articles of trade with many other fruits, such as figs, quinces, pears, apples, grapes and currants, almonds and walnuts.

The cultivation of field crops was also an important feature of ancient Greek agriculture. They adapted the grain to the soil. They chose rich plains for wheat, and cropped them at intervals with vegetables. Barley was sown where the ground was "oily and soft" while "thin and hungry" tracts they gave up to lentils, vetches, lupines and other pulses, which were cultivated on a large scale. Beans and peas were supposed to thrive best on "level and fat lands".

In light soils, they had recourse to a sort of spade-husbandry. Where ploughing was resorted to, they usually repeated the process thrice; and the third time the ploughman cast the grain into the furrow as he advanced, while a lad, following behind, broke the clods and covered the seed, to secure it against the birds.

In very hot weather, they often laboured all night, thus protecting themselves and the oxen against the sun, as well as profiting by the dew, which rendered the soil more moist and pliable. This practice might well be tried in our country. In choosing the ploughman, they carefully fixed upon one of great vigour and stature that he might be able to wield the implement easily; nor would they have him under forty years of age lest he should be unsteady in the performance of his duties. This is a sound advice which might be adopted by those who engage hired labour for agriculture.

The principal sowing season was in autumn; for as soon as the equinotical rains had moistened the earth, the sower went forth to sow, and committed to the ground the hopes of the future year. The time for wheat was September. In sowing they took care to distribute the seed equally over the field. They often made use of a sowing sieve made of wolf's hide, pierced with thirty holes, as large as the tip of fingers. To protect the seed from birds they set up scarecrows of various kinds, and had recourse to charms and enchantments.

The crops were generally weeded twice and the weeding was carefully done. When the harvest was to commence labourers collected in the market-place where they stood arranged in bands till persons hired them. They then, with sharp sickles and lightly clad, proceeded to the fields, where, dividing into two parties they commenced reaping at either end of an expanse of standing corn, each party striving which should reach the middle first. Women, in many

parts of Greece, joined in these labours. The produce of the harvest was never considered safe until it had been lodged behind strong walls in the farmyard. The implements used were the sickle and the scythe; the former for wheat and the latter for barley and inferior grains.

As a long succession of fine weather could generally be counted on, thrashing-floors were constructed in the open fields, where the grain was separated from the straw by the oxen. In winnowing, they trusted, on windy days, entirely to the breeze; but in calm weather, they made use of a machine, which, though turned by hand, would seem to have possessed great power, as we may infer from its having been used in cleansing vetches and beans. To save the chaff which was too valuable to be lost, pits were sunk all round the thrashing-floor, which, for the passage of men and cattle would appear to have been covered, except in the direction of the wind.

For immediate use the grain was sufficiently cleaned by one winnowing; but when designed to be laid up in granaries, it underwent a second cleaning process. "In the construction of granaries, they displayed great skill, and were successful in proportion; insomuch that by their method wheat could be preserved for fifty, and millet for a hundred years. The contrivances varied in various countries, but throughout antiquity, so much care was bestowed on this object that famines rarely made their appearance; and even during war the inhabitants of fortresses and besieged cities were not often compelled to surrender through lack of provisions".

The agriculturists of Greece often evinced considerable interest in the theoretical studies about the subject although they were more guided in their agricultural operations by the past experience. Naturally, rules of husbandry were transmitted from father to son. Although most of the instructions were given orally, there were some writers who occasionally produced treatises on the subject. But many of the poets embodied the ideas in their works. Besides the instructions in the various operations of agriculture studies were made on the following subjects also by the agriculturists of ancient Greece. "Observing the variations of the year; the influence of the sun and moon; the rising and setting of stars; the motion of the winds; the generation and effects of dews, clouds, meteors, showers and tempests; origin of springs and fountains; and migration of birds and other animals. All information connected with springs was peculiarly valuable in Attica, which was chiefly watered by means of wells. These, in long and dry summers, often failed, and caused among the citizens of the democracy a scarcity of vegetables, which, owing to their peculiar tastes and habits, was regarded as a national calamity". A careful observation of the weather and of all those signs by which its changes are foreshown formed an important study of the agriculturist.

SOME NEW METHODS OF SOIL ANALYSIS*

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The present communication relates to some new methods which have been recently developed in the laboratories of the Indian Institute of Science. They have been successfully applied in the study of biochemical problems relating to soils. They combine accuracy with rapidity and ease of handling and are capable of adoption in routine practice.

Carbonate, Organic Carbon and Total Nitrogen. In recent years, large number of methods have been developed for the estimation of these important constituents. Many of them are individually highly efficient, but none of them can be adopted for all the three determinations on the same sample. The method developed by Bhaskaran, Harihara Iyer and Rajagopalan fulfils that condition in addition to being extremely simple and rapid. The procedure may be outlined as follows :—

Carbonate. The soil (10 g.) is weighed out into a round bottomed flask (capacity, 300—500 c. c.), treated with 15 c. c. of water and the suspension well shaken. Syrupy phosphoric acid (sp gr., 1·8; 10 c. c.) is introduced, from above, through a thistle funnel and the suspension raised to gentle boil. The vapours pass through a wide tube (about 8″ long and 1″ wide) which acts as an air condenser. Water vapour is cooled in the condenser and drops back into the distilling flask. Carbon dioxide passes over into an absorption system which consists of a water cooled straight condenser filled with glass beads, over which standard alkali (2N) is kept steadily trickling from above. The cooling combined with the large surface exposed by the glass beads facilitates quantitative absorption of the carbon dioxide.

After boiling for about 20 minutes, the heating is stopped and the alkali adhering to the glass beads washed down into a receiving flask. The unused alkali is titrated against standard acid (2N) after treatment with excess of barium chloride (10 per cent.; 20 c. c.). The end-point is sharpened by either finishing the titration against weaker acid (N/10) or back titrating against dilute alkali until the phenolpthalein colour is just regained.

Sulphuric acid is unsuitable for the above estimation because in presence of alkaline earth carbonates—which are present in many soils—the entire quantity is not decomposed even after prolonged boiling The insoluble sulphate which is first formed, protects the

* A paper presented by Prof. V. Subrahmanyan (Indian Institute of Science, Bangalore) on behalf of Messrs. T. R. Bhaskaran, S. V. Govindarajan, C. R. Harihara Iyer, K. M. Pandalai and R. Rajagopalan before the Agricultural Section at the 23rd Session of the Indian Science Congress held at Indore (January 1936).

unattacked carbonate from reaction with the acid so that low and incorrect estimates are generally obtained. Hydrochloric acid is effective in decomposing the carbonate, but the residue is unsuitable for the estimation of organic carbon. On the other hand, phosphoric acid, if added in sufficient excess, decomposes all the carbonates (including those of alkaline earths) forming the soluble acid phosphate. The acid itself is nonvolatile and does not interfere with the subsequent estimations of organic carbon and total nitrogen.

Organic Carbon. To the residue after the estimation of carbonate, mercuric oxide (red or yellow, 2g.) is added, followed by treatment with concentrated sulphuric acid (nitrogen-free, 40 c. c.). The mixture is then just raised to boil and treated with chromic acid (sat. aq. solution, 5 c. c.) the latter being introduced through the funnel. (Care should be taken to see that none of the gases escapes through the funnel itself. If the pressure of the gas inside the flask is high, it may be necessary to blow in the chromic acid. A rubber tube extension provided with soda-lime guard is useful for the purpose). The boiling is then resumed and the water vapour together with traces of nitric acid which pass over condensed as before. Carbon di oxide is absorbed by the alkali trickling over the glass beads in the condenser. The unused alkali is titrated in the manner described above.

Total Nitrogen. The residue after digestion of organic carbon contains the entire quantity of nitrogen originally present in the soil. The major part is present as ammonium sulphate. Small proportions also occur (a) in combination with the chromium and the mercury in the digest and (b) as nitric acid, (in addition to any that may have been originally present as nitrate). The nitrogen in the former condition is released and that present in the latter reduced to ammonia by treatment with excess of alkali sulphite followed by boiling (5—10 minutes) with zinc (2 g.). (5—7 g. of pure sodium sulphite is usually required for the reductiou. The sulphite need not be weighed, but may be added in small instalments until the colour changes from emerald green to a dirty blue. There will also be the characteristic separation of the black precipitate containing mercury. Zinc should be added after the mixture has been boiling for 1 or 2 mins. for, otherwise, there may be the undesirable formation of hydrogen sulphide). After cooling, the reduced digest is distilled with excess of alkali and the resulting ammonia estimated in the usual way.

Harihara Iyer and Rajagopalan have drawn attention to the loss of nitrogen in the elementary form if chromic acid is added to a cold or moderately hot mixture of the material to be digested, with sulphuric acid. This is due to the intermediary formation of ammonium dichromate, which, on further heating, undergoes spontaneous decomposition forming elementary nitrogen. (The decomposition occurs at between 120° and 150° C.). By adding chromic acid to the boiling mixture with

2 : 1 acid (temp. 170°) the formation of the intermediary compound and the subsequent loss of nitrogen are avoided.

It is well known that the presence of halides (generally chlorides) in the soil or any of the reagents causes the formation of the corresponding free halogen and consequent loss of nitrogen. This is prevented, however, by addition of a mercury salt (preferably the oxide). The efficiency of the added mercury salt varies with different soils, but ordinarily, interference of halides upto *2* per cent. can be prevented by the treatment.

The advantages of the foregoing method may be enumerated as follows. (1) The procedure is very simple and rapid. (2) The determinations are carried out on the same sample so that undue wastage of chemicals and apparatus is avoided. (3) Interfering substances are eliminated and the accuracy of the estimate greatly increased. Given a number of sets of apparatus, an average worker can carry out 10 to 12 determinations of all the three constituents in the course of a working day.

Nitrites and Nitrates. There are several methods for the estimation of these two important constituents. A few of them are volumetric methods and yield accurate estimates, but the majority are of the colorimetric type and are generally applicable for only small quantities. Of the two constituents, the nitrite is the more difficult to estimate, largely because of its instability in presence of air and other reacting substances. As the result of this, the nitrite contents of many soils and biological materials are generally under-estimated. It has been recently observed by Pandalai that the stability of the nitrite is largely determined by the reaction of the medium ; that if the soil is first rendered slightly alkaline and then clarified to remove interfering organic matter, the resulting filtrate contains all the original nitrite. The procedure may be outlined as follows. The soil (wet or dry, 50 g.) is treated with sufficient quantity of slaked lime in the form of suspension until the medium is distinctly alkaline. It is then treated with solutions of copper sulphate (10 per cent., 5—10 c. c.) and basic lead acetate, (sp. gr., 1·24 ; 1—2 c. c.) and well shaken. This is followed by addition of a further quantity of slaked lime (with frequent shaking) until the supernatant is no longer blue, but is quite clear and colourless. The suspension is then filtered and washed frequently with water.

The filtrate is quite colourless and can be used as such for the two estimations. If there is even a faint colour, the clarification should be repeated until a clear, colourless extract is obtained. The extract is then divided into two portions one of which is used for the estimation of nitrite and the other, nitrate. If so desired, the same sample of extract can also be used for both the estimations.

Nitrite. The extract is treated with excess of standard permanganate followed by addition of dilute sulphuric acid. The mixture is well shaken and the unused permanganate titrated either directly against ferrous ammonium sulphate or indirectly (after addition of potassium iodide) against standard thiosulphate.

Direct estimation of nitrite is rendered possible by the efficient clarification which removes all interfering substances. Nitrite is the only reducing agent in the medium so that the quantity of permanganate used up gives the correct estimate of that form of nitrogen.

The estimation can also be conducted after addition of excess of standard hydrogen peroxide solution, the unused part being subsequently titrated against standard permanganate. Hydrogen peroxide is comparatively stable in dilute acid solutions, but the strength of the reagent will, nevertheless, have to be checked from time to time. On the other hand, direct titration of the acidified extract against permanganate (from the burette) yields inaccurate estimates. Nitrous vapours (NO and NO_2) are partly lost from the system so that the resulting values are generally low. Nitrites do not react in the cold with dichromate, so that it is necessary to heat the acidified solution with excess of dichromate (60—80°). Even, then, the reaction may not always be complete.

Nitrates. A further portion of the original extract is treated with slight excess of alkaline permanganate and boiled for about 15 minutes. Ammonia is removed and traces of albuminoids, if any, oxidised and driven out as ammonia. The residue, which contains only the nitrate (together with the nitrite) is then distilled with Devarda's alloy in the usual way.

An interesting feature about the foregoing estimation is the effect of minute quantities of lead (or any other heavy metal) on the smoothness of reduction with Devarda's alloy. Ordinarily, reduction with Devarda's alloy or aluminium in alkaline medium proceeds very vigorously with the result that minute quantities of alkali are often mechanically carried over with the spray. This necessitates redistillation. On the other hand, presence of minute quantities of heavy metals leads to light protective coats of those metals (or their hydrides) being found around the reducing agent so that the reduction proceeds smoothly and quantitatively. Excess of metallic salts should be avoided, for, the reaction is then so much retarded that the reduction is not complete even after several hours. In the present method, the small quantity of lead passing into the filtrate is just sufficient to render the reaction smooth and quantitative.

The foregoing method has been utilised for the determination of nitrites and nitrates in a number of tropical soils. It is also eminently suitable for the study of the changes in different seasons and at various stages both before and after manuring. The transformations in

the swamp soils, especially in the earlier stages of puddling (when the conditions are favourable for reduction of the nitrite) will also be of much practical value.

Manganese. Among the various methods for the estimation of manganese, those involving the use of bismuthate are the most rapid and, in many respects, the most convenient. The procedure consists in first extracting the manganese and then converting it into permanganate, which can be quantitatively estimated. The actual working is, however, more difficult and often less accurate than is generally recognised. In the first place, many of the commoner reagents used for the extraction—hydrogen peroxide, ferrous sulphate, zinc, reduced iron, oxalic acid and such like—do not extract quantitatively, so that a small portion of the manganese is always left behind. Secondly, the extractants themselves react with the bismuthate thus involving considerable wastage of that rather costly chemical. There is also interference from extracted organic matter, which, if present in more than minute quantities, leads to low estimates of manganese being obtained. These and other defects are obviated in the procedure developed by Harihara Iyer and Rajagopalan which may be described as follows:— The soil (10 g. or more) together with mercuric oxide (2 g.) is weighed into a conical flask (cap., 250 c. c.) and treated with excess of 2—4 N sulphuric acid, followed by pure sodium sulphite (5 g.). After the vigorous initial reaction has subsided, the suspension is raised to boil and excess of sulphite driven off as sulphur di oxide. The soil suspension is then filtered and the extract treated with sodium bismuthate (0·5 to 1·0 g.) and raised to boil. After boiling for about 1 min., the flask is momentarily taken out to see if the suspension has assumed a definite pink colour. If the colour is either not formed, or disappears rapidly after formation, more bismuthate is added (0·5 g. at a time) followed by further heating. When the colour is finally established, the suspension is filtered through gooch or Jena glass filter. The filtrate is treated with excess of ferrous ammonium sulphate and the unused portion back titrated against standard potassium permanganate in the usual way.

Chlorides interfere with the accuracy of the estimation. On treatment with bismuthate, free chlorine is formed to some extent and reacts with ferrous ammonium sulphate, thus giving exaggerated estimates of manganese. This defect is eliminated by the addition of the mercury salt (preferably the oxide) which prevents the formation of chlorine. Another source of error is the bismuthate itself which contains minute quantities of some water soluble constituent which reacts with ferrous ammonium sulphate. The error due to this, is however, generally small, being the order of 0·1 to 0·2 c. c. of N/10 solution. It is proportionate to the quantity of bismuthate used so that the necessary correction can be applied by using weighed quantities of that reagent.

The foregoing method has been successfully applied to the estimation of manganese in a large number of tropical soils. The procedure is also adapted for the study of the transformations of manganese under different conditions in dry as well as wet cultivated soils. The method can be extended to the estimation of manganese in plant and animal products after destroying the organic matter by some suitable method.

Aluminium. Although this element is one of the most abundant of soil constituents, yet it is mostly present in the insoluble form and generally inactive in the ordinary type of soils. Under certain abnormal conditions however—such as high acidity or alkalinity—its solubility is increased with the result that certain adverse effects are observed. It is yet difficult to state whether the toxicity to plants is directly traceable to the aluminium ion, but there is no doubt that its presence in abnormally large quantities often indicates such a condition.

The older methods for the estimation of aluminium in soils and biological materials are elaborate and tedious. The discovery of the new reagent, 8—hydroxyquinoline (oxine), has, however, greatly simplified the procedure and increased the accuracy of the estimation. Oxine is, not however, specific to aluminium so that care has to be taken to remove iron and other heavy metals which are generally associated with the soil. Silicon and organic matter interfere with the precipitation of the aluminium salt and must also be removed. The modified procedure developed by Govindarajan may be outlined as follows.—The material (soil, 1-2 g,) is ignited at low red heat for 2-3 hours. It is then cooled and extracted with alkali (2—4 N). The extraction must be repeated a few times so as to facilitate all the aluminium passing into solution. (Heating with alkali is undesirable, as it will increase the solubility of silica). The extract is treated with a solution of a ferric salt, (sulphate or chloride. 0 5 g.) and the resulting suspension just raised to boil. It is then cooled and filtered, a suspension of iron hydroxide in alkali being used for washing. The filtrate is rendered faintly acid and treated with a solution of oxine in acetic acid. The mixture is warmed to 70° to facilitate the precipitation of the aluminium compound and then filtered followed by washing with warm water. The precipitate is dissolved in excess of hydrochloric acid (20—30 c. c. ; 1 : 4) and titrated against bromide-bromate mixture (N/10) with indigo carmine as indicator. Alternatively, excess of the bromide-bromate mixture may be added and the unused portion determined by addition of potassium iodide followed by titration against standard thiosulphate.

The novel features in the foregoing method are that (1) the organic matter is first destroyed by ignition and (2) silicon is removed by adsorption with ferric hydroxide. The method has been successfully

fully applied for the estimation of aluminium in soils and a variety of biological materials. It has also been extended to a study of the distribution of aluminium under different conditions in the swamp soil.

Summary. (1) Elegant and rapid methods for the estimation of some important soil constituents—carbonate, organic carbon, total nitrogen (including nitrate), nitrite, nitrate, manganese and aluminium —have been described.

(2) Estimation of carbonate, organic carbon and total nitrogen (including nitrate) can be carried out on the same sample. The carbonate is first decomposed by excess of phosphoric acid and the resulting carbon dioxide absorbed in a flowing stream of alkali in a condenser filled with glass beads. The residue can be used for the wet combustion of organic carbon, chromic acid being used for the purpose. By adding the oxidising agent to a boiling mixture of the soil with 2:1 sulphuric acid, intermediary formation of ammonium dichromate and consequent loss of nitrogen are avoided. The residue contains the entire quantity of the original nitrogen mostly as ammonium sulphate, but small portions also exist (a) in combination with mercury and chromium and (2) as nitric acid. The nitrogen in the two latter forms is converted to ammonia by treatment with alkali sulphite followed by boiling with zinc. The digest is then cooled and distilled with excess of alkali in the usual way.

(3) A direct volumetric method for the estimation of nitrite and nitrate in the same sample has been described. By first treating the soil with a small quantity of slaked lime, the nitrite is first stabilised. By adding a clarifying mixture consisting of copper sulphate and lead acetate together with excess of slaked lime, organic matter and other interfering substances are removed. The nitrite in the filtrate is estimated by addition of excess of permanganate or hydrogen peroxide and back titrating the unused portion. Nitrate is determined by boiling with alkaline permanganate followed by distillation with Devarda's alloy.

(4) Manganese is extracted by treatment with sulphite in acid medium. The extract is then treated with bismuthate in presence of a mercury salt (preferably the oxide) and the resulting permanganate determined in the usual way.

(5) For the estimation of aluminium, the organic matter of the soil is first destroyed by ignition at a low red heat. The residue is extracted repeatedly with alkali. The extract is treated with an iron salt (to absorb the silica) and the resulting suspension filtered. The filtrate is treated with hydroxyquinoline (oxine) reagent in a faintly acid medium. The resulting precipitate is dissolved in hydrochloric acid and titrated against bromide-bromate mixture.

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A PRELIMINARY NOTE ON THE VARYING RESPONSE OF DIFFERENT MILLET STRAINS TO LOCAL AREAS

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The wide extent to which *Jonna* and *Korra* crops are cultivated in the Cuddapah and Kurnool districts on account of their being the staple food crops of the area, amply justify the need for effecting improvement in the productive power of these crops. A detailed examination of the existing agronomic practices in the locality reveals that apart from the essential principles underlying the system of cultivation, there exist many differences in the several agronomic aspects of raising these crops, mainly due to soil and environmental variation. The several modifications of agricultural practices adopted in these two districts, with special reference to time of sowing, spacing, seed-rate, rotation and other factors, form an interesting subject of study to the agronomist. The many varieties of *Jonna* and *Korra* grown in the tract, though they are essentially " *Pacha Jonnas* " and " *Sena Korras* " differ in their characters, with these variations in soil fertility and environmental factors.

Five strains of *Cheruku Pacha Jonna* and *Sena Korra*, varieties evolved at the Agricultural Research Station, Nandyal, were grown in several places in these two districts, in comparison with the respective locals during the 1935—36 season, with a view to ascertain the reaction of these strains to the changes in environmental conditions. The layout adopted in all the cases was randomised blocks, with six replications. The following tables give the percentage yields of the several strains in *Jonna* and *Korra* in the different localities. Their statistical significance has been worked.

Summary of the results of Jonna trial plots in Kurnool and Cuddapah districts 1935—36.

Percentage yield of grain over control.

Taluk	Place	Strains.						Whether significant or not	Critical difference
		Local (control)	Type 6.	25/102	25/106	28/3	29/68		
Nandyal.	Kanala	100	124·0	108·0	113·0	126·5	120·0	Yes.	10·65
do.	Ayalur	100	83·0	103·0	111·0	95·5	102·0	Yes.	10·00
Allagadda	Chagalamuri	100	135·0	116·0	131·5	110·5	122·0	Yes.	23·87
Koilkuntla	Koilkuntla	100	93·0	105·0	108·5	92·0	99·5	No.	
do.	Dornipad	100	91·5	108·0	97·5	86·5	88·7	No.	
Kurnool	Nanoor	100	118·0	121·5	106·0	103·0	119·0	No.	
Cuddapah	Ramaraja palli	100	105·0	68·0	152·5	107·0	118·5	Yes.	10·51
Rajampet	Kuchuvari palli	100	154·5	152·5	130·0	140·0	140·0	Yes.	16·31
,,	Noonavari palli	100	135·5	132·0	126·0	132·0	141·5	Yes.	20·44
Proddatur	Chinnadandlur	100	107·0	103·0	103·0	107·0	103·0	No.	
Giddalur	Giddalur	100	101·0	116·0	105·5	95·5	121·0	No.	

Summary of the results of the Korra trial plots in Kurnool and Cuddapah districts.—1935—'36.

Percentage yield of grain over control.

Taluk.	Place.	Strains.						Whether significant or not.	Critical difference.
		Local (control).	No. 43.	No. 69.	No. 125.	No. 132.	No. 140.		
Nandyal.	Kanala.	100	112·0	120·0	129 0	143·5	118·5	Yes.	20·55
Giddalur.		100	77 0	81·0	92·5	82·0	68·0	Yes.	19·38
do.	Cumbum.	100	82·5	111·0	123·0	125·0	125·0	No.	
Kurnool.	Gudur.	100	130·0	92·0	137·0	107·0	76·0	Yes.	16·73
Cuddapah.	Allanikhanpalli.	100	95·0	141 0	139·0	156·0	125 5	Yes.	6·46
Nandalur.	Hastavaram.	100	181·0	169 0	178·5	178·5	202 5	Yes.	16·50
Proddatur.	Korrapad.	100	91·7	101·7	101·7	92·0	92 0	No.	
do.	Peddasettipalli.	100	144·5	81·0	111 0	36·5	103 0	Yes.	13·22

Out of the 11 trials conducted, in *Jonna* and eight trials in *Korra*, there was a significant difference in six cases in the former and six in the latter. These results would indicate the variations in yields of the different strains due to variations in soil fertility. The differential response of the same strain at the different centres is also apparent in both the crops. It is clear from these results that in both *Korra* and *Jonna* crops, a cosmopolitan type of strain satisfying the requirements of both the districts, covering a wide range of soil variation, is practically a difficult object to achieve. But on the other hand by a study of the results of systematically conducted trial plots of the several strains, it might be possible to fix a type, suited to each of the localities. In addition to this, these trials would mark out the different Zones of varying cropping powers; armed with this knowledge of the relation of the several strains to the different localities, the question of spreading and popularising a strain in such well-established zones, is much simplified.

The above results are only those of one year. It is proposed to conduct these trials for two more seasons with a view to acquire information regarding the relation of these strains not only to changes in soil variation but also their relation to seasonal variation.

Research Notes.

A Note on the occurrence of *Pempheres Affinis* on *Hibiscus esculentus* in Malabar.

During my work at the Agricultural Research Station, Taliparamba in 1933, I observed the presence of *Pempheres affinis* adults on almost all *Hibiscus esculentus* plants found on the Farm. By keeping the stems, adult insects were also reared out. With a view to ascertain whether the insect was attacking cotton or was only a casual visitor to the *Hibiscus esculentus* plants a minute examination of all the varieties of cotton—*Uganda, Buganda, Durango, Zululand Hybrid*, and *Karunganni*—was made. It was an agreeable surprise to find that all the cotton varieties showed complete immunity from *Pempheres* infestation.

An experiment was conducted recently to study the normal intensity, of infestation in *H. esculentus*. Six mature *H. esculentus* plants, each averaging about 50" in height were enclosed in a bell-jar after being cut into pieces of about 10" length. The cage was started on 15—12—35; the first emergence of *Pempheres* was recorded on 19—12—'35. The emergence of adults continued till 25—1—'36 and gave a total of 96 males and 121 females.

The emergence indicates that *H. esculentus* is a host plant for *Pempheres affinis*. I have observed the insect in other places also on the West Coast, infesting the same crop. The factors responsible for the absence of the pest on cotton here have yet to be studied.

Agricultural Research Station, Taliparamba. 17—3—'36.

E. R. Gopala Menon, Entomology Assistant.

Gleanings.

New dust replaces Arsenic. Search for a non-poisonous insecticide that might be substituted for arsenic and that, at the same time, would give effective control of insect pests of vegetables, has been rewarded by the discovery of *derris*, a tropical plant from which a dust possessing marked insecticidal properties can be produced. Entomologists at the State Experiment Station at Geneva, New York, have tried out this new material against worms on cauliflower and against the Mexican bean-beetle, with a high degree of success.

" Although *derris* is commonly referred to as a new insecticide, it is well to remember that centuries ago natives of Borneo and the Malay States used this plant as a source of poison for fish and for their arrow heads," says a statement from the Experiment Station on this subject. " The fact that it is non-poisonous to man when taken through the mouth has recently given impetus to its development as an insecticide. The dust is made from the ground roots, and it is generally agreed that the chief active ingredient is a substance known as rotenone. A good grade of powdered *derris* root will contain 4 or 5 per cent. of rotenone." In tests carried on by the Station specialists, ground *derris* root diluted with talc so as to give a dust containing 0·5 per cent. of rotenone has given effective control of caterpillars on cauliflower and of the Mexican bean beetle. The method and frequency of application should follow much the same programme as that employed in the use of arsenical dusts. " In general, it will probably be more satisfactory to purchase the material ready mixed unless the grower has good facilities for mixing dusts," concludes the statement from the Experiment Station. " Owing to the fact that *derris* deteriorates rapidly on exposure to air and light, the container might be kept tightly closed between applications. Dusting should be at the rate of 25 or 30 pounds per acre, and the material can be applied with a power duster or with a good rotary hand duster. In gardens or small plantings, the dust may be placed in a cheesecloth sack and sifted over the plants." (*Scient. Amer.*, Vol. 154, No. 4).

Zinc Sulphate for Citrus trees. Dr. A. F. Camp, Horticulturist at the Florida Agricultural Experiment Station, Gainesville, Florida, has obtained striking results in the use of zinc sulphate sprays on citrus trees affected with frenching. Frenching is distinguished by a yellowing between the veins of the leaves, with the areas along the veins and the edge of the leaf remaining green. If the trouble is severe, the leaves are very small and the twigs short, giving a bushy appearance to the tree. The twigs die back from the tip and are particularly susceptible to cold damage, even in mild cold spells. In the severest forms of frenching,

large twigs and even branches die and the trees become progressively smaller, giving an extremely low yield of small hard fruit.

On a rather heavy soil, orange trees which had been carefully manured and cultivated, had never grown satisfactorily, but applications to the soil of one quarter to one half of a pound of zinc sulphate twice a year, gave a marked response, and normal growth and fruiting resulted in a short time. On the lighter soils of the Florida grapefruit area, however, the soil applications failed to give satisfactory results, and it was thought for a time that a different type of frenching was responsible for the poor growth. It was eventually discovered that the trees responded with exceptional rapidity to zinc sulphate sprays, giving vigorous growth in less than six weeks after the application. The most reliable spray was found to be a zinc-lime mixture of the following composition:—

5 lb. zinc sulphate (89 per cent. pure).
2½ lb. finely ground hydrated lime.
50 gallons of water.
Calcium caseinate or blood added as spreader.

The zinc sulphate is dissolved separately by adding it slowly to a small amount of water with vigorous stirring. The hydrated lime is added gradually to the main bulk of water to make a good suspension, and the zinc sulphate added slowly to this, with thorough mixing. The spreader is either screened into the zinc-lime mixture or mixed separately with water, according to special instructions by Dr. Camp, from whom a copy of the complete circular on the subject of zinc sulphate and water can sometimes be used successfully, but burning frequently results, and such a spray is not recommended. The amount of lime specified above is about the minimum that is thoroughly safe at all times. (*Tropical Agriculture*, Vol. XIII, No. 4).

Milking as an Art. Milking might be defined as an art, inasmuch as some persons are more fitted temperamentally for the work. A person who is rough in manner and irritable in temper can never establish tue sympathy between the cow and the milker that is necessary for good results. The milk yield is adversely affected by rough treatment, and the capacity of production over the lactation period is reduced accordingly. Good herdmasters are very careful in the selection of milkers, and will not employ persons who are manifestly bad-tempered or even who profess a dislike for the work. The secretion of milk entails the expenditure of a large amount of nervous energy on the part of the cow. Noise or disturbance, ill handling of cows, roughness in the work, and even spasmodic or intermittent application all tend to check the flow of milk. In the course of a few days decline in production is evident. The system of recording the weight of milk at each milking is an excellent one, and well worth the amount of time the recording occupies. A careful herdmaster will be quick to note any decline in production, and will want to find the reason for it. (*Queensland Agricultural Journal*, Vol. XLV, Part 3).

A new method of making clarified butter. In the older methods and in the method used in most countries today butter is prepared and clarified later. It has been pointed above that the ripening of cream cannot be controlled very easily owing to the risk of contamination by undesirable types of bacteria. These unwanted bacteria give rise to many side products which though present in minute amounts detract from the flavour of the butter produced. Also over-ripening of the cream with a large production of acid results in a butter of poor-keeping qualities. Further, even when clarified, butter from highly acid cream is more liable to autoxidation than if made from cream of the right acidity.

Also the butter has to be churned correctly otherwise efficient washing is impossible and the resulting clarified butter possesses some of the rancidity developed during the ripening of the cream.

If there is to be any large production of clarified butter much of the work will have to be left to natives. This means that the less skilled the work, the more capable will the native be to carry it out. The making and washing of butter is a skilled business, but turning a separator is mechanical. Clarifying butter has been regarded as an art, though, as shown earlier, if certain observations are made then it loses its right to be regarded as such.

In any case the boiling process cannot be eliminated.

In an effort to simplify the production of clarified butter so that a first class article could always be turned out, the direct boiling of cream was tried. Cream contains very much more protein and water than butter and the only reason for making butter as intermediate step in all the older processes is to reduce the quantities of these before boiling.

As was to be expected, both in the laboratory and creamery tests on the boiling of fresh cream, the direct boiling was not a success.

The large amount of protein present caused some to stick to the bottom of the pan and char, thus reducing the quality of the final product.

An attempt was then made to reduce the amount of protein present by washing the cream with water. This was accomplished by mixing the cream with water so as to make a volume equal to half that of the original milk separated. This cream emulsion was then reseparated. By this means the protein content was reduced to about the same percentage as is found in butter. Laboratory trials showed that this washed cream could be clarified without difficulty. Further trials on this method have been made on the Government Dairy Farm and on a large scale in one creamery. All the reports show that this method is working perfectly satisfactorily under creamery conditions.

In this washed cream method the small amount of rancidity present in the freshly-separated cream from native milk is partially removed by washing. The small amount left in the washed cream disappears during boiling. The result is that the product can be guaranteed absolutely free from rancidity. Further, since it is made from fresh cream its keeping qualities are better than that from butter produced from acid cream.

By general consent this clarified butter is graded as the best turned out in the Territory. It has a good colour, is always solid below 30°C and in my opinion is better than the best Indian-made article. Its taste resembles butter very closely. The Vitamin A content of this fresh cream clarified butter is much (3 times) higher than in the normal creamery product.

The loss of butter fat in reseparating the milk will not be more than is lost in the buttermilk, the butter left in the churn and on the butter-working table. Yields from the creamery confirm the small scale laboratory tests that there is no appreciable difference in yield of clarified butter between the standard and the new methods.

The washing of the cream and reseparating is absolutely mechanical and eliminates the need for an intelligent butter maker. This means that there is a saving on the utensils and skilled labour whilst a better product is turned out. (*Extract from the Bulletin of the Imperial Institute for January—March 1930.* Vol. XXXIV, No. 1, P. 42).

WEEKLY MENU

VEGETARIAN

	AT MINIMUM COST. Suitable for manual workers.				AT MODERATE COST. Suitable for brain workers.			
DAYS	7 A. M.	12 NOON	4 P. M.	8 P. M.	7 A. M.	9 A. M.	1-30 P. M.	8 P. M.
Mondays Wednesdays Fridays	Rice roti & nut-cake chutnee.	Kitchri & ghee, vegetable curry and curds.	Soya bean coffee.	Rice and dal, roti, butter. Salad of sprouted grams, vegetable curry, curds and papayya or banana.	Soya bean coffee.	Rice & dal, ghee, salad of sprouted grams, vegetable curry and curds.	Ladu, cocoanut chutnee.	Roti, butter, vegetable curry, curds and fruit.
Tuesdays Thursdays Saturdays	Do.	Roti, ghee, vegetable curry, raw onion & curds.	Do.	Rice and dal, ghee, salad, vegetable curry and curds.	Do.	Rice & dal, ghee, salad vegetable curry and curds.	Roti, nut-cake chutnee, banana.	Kitchri, roti, butter, vegetable curry, and curds.
Holidays or alternate Sundays	Soya bean coffee or tea.	Rice and dal, ghee, puri and some pudding, salad, vegetable curry. 'Usal' of sprouted seeds & curds.	—	Rice, vegetable curry and curds	Do.	Rice, dal & ghee, puri and some pudding, salad, vegetable curry. 'Usal' of sprouted seeds and curds.	—	Roti or rice, vegetable curry and curds.

NON-VEGETARIAN

DAYS	7 A. M.	12 NOON	4 P. M.	8 P. M.	7 A. M.	9 A. M.	1-30 P. M.	8 P. M.
Mondays Wednesdays Fridays	Rice roti & nut-cake chutnee.	Kitchri, egg and vegetable curry.	Do.	Rice and dal, roti, vegetable curry and salad.	Do.	Rice & dal, ghee, roti, egg & vegetable curry and salad.	Ladu, cocoanut chutnee.	Rice & dal, roti, vegetable curry and fruit.
Tuesdays Thursdays Saturdays	Do.	Roti, egg and vegetable curry and raw onion.	—	Kitchri, meat and vegetable curry, salad of sprouted grams, curds and fruit.	Do.	Do. With salad of sprouted grams and curds.	Roti, nut-cake chutnee, banana.	Kitchri, ghee, meat or fish and vegetable curry.
Holidays or alternate Sundays	Soya bean coffee or tea.	Rice & dal, puri and some pudding *or* meat or fish preparation, salad, vegetable curry, 'Usal' of sprouted seeds and curds.	—	Rice and vegetable curry.	Do. or tea.	Rice, dal & ghee, fish or meat preparation *or* puri and some pudding, salad, vegetable curry and curds.	—	Roti, vegetable curry and fruit.

Menu for Children.

Feeding times for children should generally be those mentioned for brain workers. They should be given a cup of milk or one egg and soya bean coffee extra at 4 P. M.

Directions.

1. The above are only specimen menus. Many other preparations and combinations of foods can be substituted for those recommended above provided they are done in keeping with the advice given in the pamphlet on 'Balanced Diets'. The meals recommended for morning and evening are interchangeable Where whole milk is cheap i. e., one anna and a half a lb, it should be used instead of skim milk and butter.

2. In the case of those taking the minimum cost diet 'Broken Rice' should be understood wherever 'Rice' is mentioned.

3. 'Kitchri' is usually made of rice and either tur dal or masoor dal (2 parts of rice and one of pulse).

4. Malted Jowar :--About 6 ounces of jowar should be malted and used in one week.

5. 'Rotis' are to be prepared of *mixed flour* of the following ingredients except bran. They should be mixed in the following proportion and sent to the local mill. Fresh bran should be added to the flour twice a week.

Malted jowar	about 15 per cent.		Malted jowar	about 15 per cent.
Soya beans	,, 20 ,,	or	Soya beans	,, 25 ,,
Bran	,, 15 ,,		Bran	,, 10 ,,
Wheat	,, 50 ,,		Rice, bajri, or jowar	,, 50 ,,

6. 'Usal' is a cooked and spiced preparation of sprouted pulse seeds.

7. Soya Bean Coffee :—The beans are roasted like coffee beans and ground to a fine powder for use.

8. Some of the ground-nut cake should be used for chutnee and the rest should be mixed with dal, curries or 'usal'.

9. Salad :—Tomato, yellow carrots, cucumber, raddish, onion, cabbage etc., and some leafy vegetables can be used uncooked. Clean them in cold water and then in hot water so as to remove dirt and destroy insects etc., cut to pieces and add curds and condiments to taste. Sprouted horse grams should be used uncooked with or without the addition of salads given above.

10. Skim Milk Curds :—Churn the milk powder in water (1:9) and boil for five minutes. Prepare its curds just as you do of ordinary milk.

11. Lunches should be home-made and should be taken to the office or factory in a tiffin carrier.

(*The Bombay Presidency Baby and Health Week Association*)

Review.

Indian Forest Records : (New Series). *Entomology*: Vol. I., No. 6., "*On the Biology of the Braconidae*", pp. 105—138 (1935); No. 8, "*On the Biology of the Ichneumonidae*", pp. 151—168 (1935); No. 9, "*On the Biology of the Tachinidae*", pp. 169—184 (1935) By C. F. C. Beeson and N. C. Chatterjee. Messrs. Beeson and Chatterjee of the Forest Research Institute, Dehra Dun have done a distinct service in the cause of biological control in bringing to light the parasitic fauna on some important forest insects chiefly forest defoliators and borers, mostly Lepidopterous and Coleopterous ones. These parasites must be studied in conjunction with a paper on "The Biological Control of Teak Defoliators" by C. F. C. Beeson (Indian Forester, Vol. 60, pp. 672—683, October 1934), wherein the author discusses the theory of biological control in connection with the two teak defoliators

Hyblaea puera and *Hapalia machaeralis*; and in this contribution he makes a reference to his making a survey of the distribution of parasites and predators of teak insects.

A survey of the insect parasites is essential so that it may give one an idea as to the regions where they are abundant and places where either they are found in small numbers or completely absent. And this in its turn would afford a working knowledge as to the introduction of particular parasites into regions where they are absent. Therefore it is that even before one thinks of biological control, it is incumbent upon him to ascertain the parasitic fauna present in the different regions. And towards this end the authors have recorded in these three numbers the Braconid and Ichneumonids among the Hymenoptera and the Tachinids among the Diptera.

In the words of the authors the objects of the studies are: "a) to ascertain the composition and sequence of parasitism of the chief defoliators of trees such as teak, sal, shisham; and b) to determine the relative importance of parasites and other factors in the natural control of borers of timbers."

The treatment is similar in all the three cases. Each number begins with an abstract wherein the parasites and their hosts are cited. Then follows a foreword in which are given the implications of biological control in relation to the different parasites parasitic on the different hosts. The distribution of parasites and their hyperparasites is given regionally—the different regions being: I. the north-west region comprising Dehra Dun; II. the central region represented by Hosangabad, Central Provinces and parts of Orissa; III. the southern region represented by Nilambur plantations, Madras and South Coorg; and IV. the eastern region comprising records from Bengal, Burma and the Malaya Peninsula.

The authors bring about the import of the following aspects of biological control by a study of the regional distribution of the parasites and their hyperparasites:

i. the distribution of these parasites and their hyperparasites is very irregular and uneven;

ii. the irregular distribution in its turn makes biological control easy as it gives an idea as to where they are abundant and where absent, thereby making the "introduction and establishment of useful parasites in regions where they are at present absent" easy;

iii. it also gives an idea as to the presence or absence of the hyperparasites on which the failure or success of the introduction of new parasites depends;

iv. in some cases the authors have recorded them to be present even in Europe, thereby making it evident that the distribution is still wider;

v. by noting down the distribution, one is able to find out the factors responsible for any variation in the degree of incidence.

In the body of the paper the parasites are arranged in an alphabetical order with available notes on their hosts, distribution and bionomics.

Among the Braconids seventy species are recorded as being parasitic on "a) *Hapalia machaeralis* and *Hyblaea puera*; b) on *Dinoderus* boring bamboo, or *Lyctus* and other *Bostrychids* boring dry wood; c) parasites of various other defoliators; d) of Curculionid and Cerambycid wood borers."

The following may be said to be important from an agricultural aspect: *Apanteles glomeratus* on *Pieris brassicae*, L feeding on cabbage and mustard; *Apanteles obliquae* Wlkn., on *Amsacta* sp.; *Apanteles papilionis* Vier., on species of *Papilio* feeding on citrus; *Apanteles ruficrus* Hal., on *Spodoptera mauritia* Boisd., and *Microplitis maculipennis* Szep., on the castor semilooper *Achaea janata* Linn.

Fifty species are recorded among the Ichneumids of which ten species are parasitic on the teak defoliators *Hapalia machaeralis* and *Hyblaea puera* Cram., with seven species of hyperparasites on the parasites of the teak defoliators; and a number of species of *Henicospilus* being primary parasites of Lymantridae. In addition, several species *Dioctes. Cremastus* etc., are also recorded. Of these the following are agriculturally important e. g., *Charops erythrogaster* Ashm., on *Achaea janata*, L., a pest of *Ricinus communis*, and *Eupterotis* sp.; *Cremastus flavo-orbitalis* Cam., on *Antigastra catalaunalis* Dup., feeding on *Sesamum indicum*, *Chilo simplex* Butl., a borer of rice, cholam etc., *Euzophera perticella* Rag., a borer of the shoots of Brinjal, tomato, chilli etc., *Leucinodes orbonalis* Guen., a borer of the shoot of brinjal and potato; *Dioctes argentipilosa* Cam., on *Laphygma exigua* Guen., a cosmopolitan feeder on agricultural crops especially in the earlier stages; *Melcha nursei* Cam., on *Earias fabia* Stoll., *Earias insulana* Boisd., the two cotton bollworms, and *Plusia orichalcea* F.; *Microtoridea lissonota* Vier and *Neopimploides syleptae* Vier., on *Sylepta derogata* F. the common cotton leaf roller.

Now among the Tachinids forty-one species have been mentioned and the authors state "that several species of European Tachinidae have been reared from hosts in Indian region." Among the agriculturally important are *Erycia nymphalidophaga* Bar., on *Papilio demoleus* L., feeding on citrus; *Ptychomyia remota* Aldr., feeding on cotton; *Sturmia inconspicuella* Bar., on *Spodoptera mauritia* Boisd.; *Sturmia sericariae* Corn on *Papilio demoleus* L.

From these it can be seen that the parasitic fauna of forest insects are also important to an agricultural entomologist as the former are also parasitic on insect pests of agricultural crops. Therefore a study of the parasites in both cases is important because the two are woven together. And the importance of it is all the more in effecting biological control for one gets a wider scope for breeding parasites, which have got a number of hosts, for improving the rearing technique; in view of the presence of large number of hosts, it is possible that the parasites may be had in abundance right through the year on one host or another; and lastly their wide distribution gives ample scope for studying the factors responsible for their increase or decrease in the course of the year. In order that biological control may be successful, two points are essential viz., overlapping of generations in the case of the host so that the parasite may have the right stages for parasitising at all times; and the presence of a number of alternate hosts for the parasite so that they may be had right through the year. The latter is fulfilled by distributional studies.

Among the Braconids are mentioned species of the genus *Spathius*. A species of this genus also appears to attack the stem weevil of cotton viz., *Pempheres affinis* F., in South India, though only to a very negligible extent in nature. But it appears to be parasitic on the Bostrychids that attack the dried up cotton stalks which are dead on account of Pempheres. Therefore, if one comes across the correct host, then it is easy to get in at the alternate hosts of the parasite. For, in this case, species of *Spathius* are recorded as parasitic on the several Bostrychids, Scolytids and Curculionids. Thus breeding of the parasites right through the year is facilitated.

Therefore it is essential that a study of the parasites of insect pests of agricultural crops be done along the lines shown by the Forest Entomologist in these numbers. And this will go a long way in broadening our outlook with regard to control by natural enemies, instead of restricting ourselves to mere agricultural crops. The importance of a study of both is well exemplified in these numbers and the authors have given an impetus as it were, towards the mode of studying the parasitic fauna.

V. M.

Agricultural Jottings

BY THE DEPARTMENT OF AGRICULTURE, MADRAS

Rice Research Station, Berhampore. With the assistance given by the Imperial Council of Agricultural Research, the Rice Sub Station at Berhampore came into existence in March 1932. On account of the temporary nature of the station, the two most important lines of work namely, the survey of the tract with regard to its varieties and the improvement of the main varieties by evolving strains and the carrying out of the necessary cultural and manurial trials relating to the tract, were taken up first. Four years' work has finished and important results obtained are the following:—

120 varieties of the tract have been studied and pure lines have been evolved from all of these. Selection work was confined to half a dozen amongst these which are the most important in the tract. These selections from *bayyahunda*, *ratnachudi*, *boroponko*, *mypali*, etc. have undergone already two years' trial on the station and several of these have been found to give 15% and more of increased yield over the ryot's seed. With another year's trial on these at the station the best of them will have to be tried at different centres in the tract to gauge their suitability. It is expected that in another 2 or 3 seasons we would have arrived at the best of these for multiplication and distribution to the people.

As a preliminary to evolving strains mass selected bulks have been obtained in the two varieties, *bayyahunda* and *ratnachudy* and the seed distributed to the ryots has been very much appreciated.

A large number of cultural and manurial trials have been carried out during the last three seasons and some important results have been obtained with regard to the optimum spacing to be given to seedlings at planting, the optimum age of seedlings to be planted, and the comparative merits of broadcasting directly and transplanting, etc. With regard to manurial trials, green manuring has been found to be very economical, yield increase of 20% being obtained even with an application of 2 to 4 thousand pounds of green leaf. The trials with fertilisers, though some of them have been found to give a substantial increased yield either by themselves or in combination with green leaf, the value of the increased yield invariably does not cover the cost of the fertilisers. These trials will have to be continued sometime longer before any definite conclusions could be drawn from them.

Besides the above, certain crosses have also been made chiefly for studying the inheritance of fineness and texture of rice.

The House Fly Maggot Trap—An Effective Control of Flies. It is common knowledge that flies breed in manure and other refuse matter where their young ones—called maggots—find plenty of food for their growth and development. With a knowledge of the habits and life history of the fly it is possible to prevent its multiplication This is by the use of what are known as fly maggot traps which work on the principle of attracting flies to fresh manure in a receptacle for egglaying and trapping and destroying the maggots that hatch out, making use of their migratory instinct. The trap consists of a rectangular wooden frame 2′×2′×2′ fitted with ½″ mesh wire netting on all sides, open at the top and provided with a plank at the bottom about 6″ from the ground level. All round the trap at the level of the plank is a U-shaped drain of galvanised iron fitted with ledges on either side, slanting towards the drain. The drain is filled with water which can be drained when necessary through a hole at the

bottom on one side which is plugged with a cork. The trap is placed near cattle sheds or other places where flies abound and fresh manure is put into it daily in small quantities so that it gets filled in four or five days. Attracted by the fresh manure, flies come and lay eggs. The maggots that hatch out begin to wander about and move towards the outside and, in so doing, come out through the meshes of the wire netting and fall into the drain round the trap and are caught. These are collected daily and destroyed The water in the drain is also renewed. To provide a continuous supply of fresh cowdung for egglaying and also to ensure thereby continuous trapping of maggots every day, instead of a single trap, a set of three is used, the baits in each being put in one after the other so that by the time the third trap gets full the first one would have got exhausted and could be renewed.

Maggot traps may be made in any design provided the principles of their working are borne in mind. A simpler and cheaper trap working almost as efficiently as the one described above has been devised by making use of a galvanised sheet of iron 6′×3′. The sheet is bent along the length to form a trough and hung up a little above ground level. Manure is put in as in the case of the former trap in small quantities every day until it gets full. The maggots in the manure travel along the length of the trough and drop down at both the ends of the trough and are caught in two shallow wide basins (earthen basin will serve well) containing water placed exactly under the two open ends of the trough.

Fence substitutes for Prickly Pear. At the recent budget session, a member of the Legislative Council complained that while through the effort of the Agricultural Department prickly pear had been practically destroyed, the Department had taken no steps to suggest to ryots substitutes for prickly pear as a fence. The Department realising its responsibility has been for some time testing different live fences at several of its Agricultural Research Stations. In fact, an article in the Villagers' Calendar for 1936 contains useful information on this very subject.

The plants recommended in the article are—

Mullukiluvai (Balsamodendron berryi).
Chadurakalli (Euphorbia antiquorum).
Bonthakalli (Euphorbia royalena).
Tirukalli (Euphorbia tirucalli).
Kathalai (Agave Americana) Aloes.
Sisal Hemp (Agave sisalana).

These plants are available practically everywhere and it is left to the individual to choose what he considers suits his local conditions. Readers are advised to peruse the article referred to in the Villagers' Calendar and to apply to the nearest Agricultural Demonstrator for selection of the material most suitable for their locality.

Studies of the manurial reserves of the village. At Velacheri near Madras where farming on a co-operative scale is being attempted by the Agricultural and Co-operative Departments, the Agricultural Demonstrator in charge has been recently conducting a survey of the village. An enquiry into the manurial resources of the village revealed that out of the 699 houses in the village, 600 houses use cowdung as fuel. Each family burns 40 cowdung cakes daily and this is obtained from the droppings of 2 pairs of animals. At the above rate, the total consumed in the village is reckoned at 8000 cartloads of cowdung. This would be sufficient as manure for at least 1600 acres of dry land which are at present being raised with crops year after year without any manure at all. Besides, hundreds of cartloads of cowdung cake are daily sent to the Madras City from the surrounding villages for being burnt as fuel and the total annual loss of such a valuable manure is colossal seriously affecting the production of crops in the district. In

a country where soils are so deficient in organic matter it is essential that serious attention should be paid to the provision of fuel other than cowdung.

Lucerne. The Department recommends several fodder crops of which Lucerne is one. It will amply pay the growers near big towns and racing centres where a large number of horses are kept. For example, the Madras Race Club is said to consume in the neighbourhood of 400 lb. a day valued at Rs. 12—8—0. It is reported to be obtained all the way from Bangalore. Attempts are now being made to grow it at Velacheri, a village already mentioned above and situated near the Guindy race club. The crop, if grown under proper conditions, is expected to yield about 50,000 lbs. of green stuff annually. The gross value, estimated liberally at 100 lb. per rupee, will amount to Rs. 500 per acre while the cost of cultivation is not expected to be more than Rs. 200. Lucerne is a good succulent food not only for horses but also for cattle—working and milch, and poultry.

Fish Guano In the West Coast very large quantities of different varieties of fish are caught and used in the preparation of sardines and in the extraction of oil. The refuse after the extraction of oil is known as "fish guano." Some varieties of fish, particularly those which are small in size are simply dried in the sands on the beach. Such beach-dried sardines which cannot be used as food are used as manure.

One variety, "White bait" or known locally as *Kollataru* was recently sent to the Government Agricultural Chemist, Coimbatore, for analysis and was found to contain as much as 10·4% nitrogen and 4·4% phosphoric acid. It is already being used as manure for sugarcane with very good results.

College News and Notes.

The Principal of the College and ex-officio President of the Union Mr. R. C. Broadfoot is proceeding home on leave and Mr. R. W. Littlewood, Dy. Director, Live Stock is appointed officiating Principal of the Agricultural College.

College Day and Conference. The Hon. Sir K. V. Reddy will as officiating Governor of Madras inaugurate the Diamond Jubilee celebrations, and the Hon. Mr. P. T. Rajan will preside over the College Day and Conference. The proceedings will commence on Wednesday the 29th July and last for four days. It is likely that a conference of all the Gazetted Officers of the department will be arranged during the conference week, and it is expected that Mr. C. J. Paul, Development Secretary will preside over the Gazetted Officer's Conference. The Managing Committee of the Union extend their invitation to all the members of the department, and the readers of the Madras Agricultural Journal, to attend the Diamond Jubilee celebrations, and make the function a success.

The Late Sir M. Ramachandra Rao Garu. In the death of Sir M. Ramachandra Rao, South India loses one of its leading public men, and the Madras Agricultural Students' Union, one of its sincerest well wishers. His interest in the welfare of the ryot was sincere and real. and his contribution towards the co-operative and banking movements in the presidency is well-known. He was one of the distinguished presidents of our College Day Conference. We tender our heart-felt condolence to the members of his family.

Mr. M. Rajagopala Iyer. It is with deep regret that we announce the death of Mr. M. Rajagopala Iyer, assistant lecturer in chemistry on the 21st inst. Mr. M.

Rajagopala Iyer, was one of the active members of the Union, and was a member of the Managing Committee, as Treasurer for nearly seven years. We offer our sincere condolence to his relatives.

Research Engineer. Mr. M. Lakshmipathi Mudaliar, is in charge of the Research Engineer's Section, in the absence of Mr. N. G. Charley on leave.

Ramasastrulu Munagala Prize. The last date for submitting papers is 15th June.

B. Sc. Ag. Examination Results. Elsewhere in this issue is published the results of the B. Sc. Ag. examination held in 1936.

ANNOUNCEMENT

The Diamond Jubilee Celebrations of Agricultural Education in India and the 25th College Day and Conference will commence on the 29th July 1936. His Excellency the Governor of Madras will inaugurate the proceedings. The Hon. Mr. P. T. Rajan will preside over the conference. An Exhibition will be staged along with the Conference.

The annual general body meeting of the Union will be held on Sunday the 2nd August at 8-15 A.M., when the annual report and budget for the next year will be presented for adoption, and the office-bearers for 1936—37 elected.

Members desirous of moving propositions at the meeting are requested to give due notice, to the Secretary, to reach him not later than 1st July 1936.

Weather Review (APR L 1936).

Summary of General Weather Conditions. Rainfall was general in the Presidency on the first day of the month, but thereafter weather was dry, with high day temperature. A depression formed in the centre of the Bay on the 23rd but it moved in a North Easterly direction after intensifying into a storm and crossed the Arakan coast. The depression did not influence weather in the Peninsula.

Rainfall was generally below normal throughout the Presidency and markedly so on the West coast, Mysore and Coorg, and the hills and in parts of the Circars and Deccan.

Day temperatures were high on the East coast between Nellore and Madras and in the Deccan, Nellore and Rentachintala recording maximum of 111°F on several occasions.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st	Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	0·0	−0·8	4·8	South	Negapatam	0·4	−0·2	8·8
	Berhampore*	0·0	−0·9	5·5		Aduthurai*	0·1	−0·9	5·7
	Calingapatam	0·2	−0·7	3·2		Madura	2·5	+0·4	7·8
	Vizagapatam	0·2	−0·5	5·1		Pamban	4·9	+3·3	8·0
	Anakapalli*	0·1	−1·3	0·0		Koilpatti*	1·4	−1·6	6·3
	Samalkota*	1·1	+0·5	9·7		Palamkottah	1·5	−1·0	5·7
	Maruteru*	0·3	−0·2	4·4					
	Cocanada	1·9	+1·3	6·6					
	Masulipatam	0·4	−0·2	4·8	West Coast	Trivandrum	0·1	−4·4	3·5
	Guntur*	1·3	+0·7	9·4		Cochin	2·1	−2·6	4·7
						Calicut	1·1	−2·2	11·5
Ceded Dists.	Kurnool	0·8	+0·2	2·5		Pattambi*	1·1	−2·2	6·4
	Nandyal*	0·1	−0·3	1·7		Taliparamba*	0·9	−1·7	1·9
	Hagari*	0·0	−0·9	1·7		Kasargode*	0·0	−3·5	2·4
	Bellary	0·1	−0·7	0·4		Nileshwar*	0·7	−1·0	2·4
	Anantapur	0·8	+0·3	0·9		Mangalore	0·3	−1·0	4·0
	Rentachintala	—	—	—					
	Cuddapah	0·4	−0·1	1·1	Mysore and Coorg	Chitaldrug	0·3	−0·6	0·6
Carnatic	Nellore	0·3	−0·1	2·2		Bangalore	0·1	−1·2	1·1
	Madras	0·5	0·0	4·0		Mysore	0·5	−1·9	3·1
	Palur*	0·7	−0·7	4·4		Mercara	0·2	−2·4	4·1
	Tindivanam*	1·0	+0·1	4·6					
	Cuddalore	0·2	−0·4	4·3	Hills.	Kodaikanal	0·5	−3·8	7·3
Central	Vellore	0·7	−0·3	1·7		Coonoor*	8·5	—	23·3
	Salem	0·9	−0·9	4·9		Ootacamund*	0·0	0·0	0·0
	Coimbatore	0·4	−1·0	3·9		Nanjanad*	0·9	−2·1	6·1
	Coimbatore Res. Inst.*	0·8	−1·4	3·7					
	Trichinopoly	4·0	+2·3	6·0					

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Weather Report for Research Institute Observatory.

Report No. 4/1936.

Absolute Maximum in shade	100·5°F
Absolute Minimum in shade	66·5°F
Mean Maximum in shade	95·5°F
Departure from normal	— 0·4°F
Mean Minimum in shade	72·8°F
Departure from normal	— 0·1°F
Total Rainfall	0·81"
Departure from normal	— 1·35"
Heaviest fall in 24 hours	0·65" (Recorded on 1–5–'36).
Total number of Rainy days	2
Mean daily wind velocity	1·3 M. P. H.
Mean Humidity at 8 hours	69·2%
Departure from normal	— 1·6%

Summary. Dry weather prevailed during this month. The rainfall was below normal by 1·35". The mean humidity was in defect by 1·6%. The highest maximum temperature recorded was 100·5°F. Skies were moderately clouded.

Departmental Notifications.

Gazette. Mr. R. N. Sundaram to officiate as Dy. Director, II Circle. Mr. G. R. Srinivasan to officiate as Paddy Specialist vice Mr. K. Ramiah on leave. Messrs. U. Vittal Rao, A. Ramaswami Iyer and V. T. Subbiah Mudaliar to officiate as Asst. Directors of Agriculture in IV, II. and VI circles respectively.

Subordinate Service. Leave. Mr. D. S. Subramania Iyer, A. D., Rasipuram, l. a. p. for 3 months from 1—5—36. Mr. S. Kuppuswami Iyengar, A. D., St. Thomas Mt., l. a. p. for 3 months and 29 days from 11—1—36. Mr. G. L. Narasimha Rao, A. D., Gannavarum, l. a. p. for two months from 11—5—36. Mr. K. V. Natesa Iyer, A. D., Trivellore, l. a. p. for two months from 13—5—36. Mr. R. Venkatarama Iyer, A. D., Vridhachallam, l. a. p. for two months.

Transfer. Mr. K. Sivasankara Menon, A. D., C nnanore to be F. M, Taliparamba. Mr. S. Muthuswami, Demonstrator, to Srivalliputtur.

1936 B. Sc. Ag. Examination Results.

LIST OF SUCCESSFUL CANDIDATES

Adinarayana Reddi, Y. Albuquerque, S. D. S. Annaswami, S. Arunachalam, T. Colaca, J. Hanumantha Rao, C.* Ittyachen, C. T. James Albert Rajiah, J. D.* Jayaram, K. Joshua, S. Kannayyan, K. Kelukutti Menon, M. Krishnamurthi, R. Krishnan, R. H. Lingayya, N. K. Murugesan, G. Parasuraman, N. A. Raghavan, A. Rajababapanayya, K. Rajaraman, S. Ramanarayana Menon, K. Ramanatha Rao, H. Ramanatha Rao, P. Ranganathachari, N. Rayadrug Ali Hyder. Sangameswara Sarma, S. Shanmugasundaram, R. Sridharan, N. V. Venkataramana, G. Venkataramana Rao, V. G. Narasimhamurti, G. Satyanarayana, D. Venkataramaya, M.

First Year Examination. Abdul Hafees. Aga Muhammad Bawker. Anantachary, P. S. Balasubramanian, A. Brahmanandam, V. Chellappa, G. V. Joseph Doss, S. V. Kothandaraman, E. S. Krishnaswami Nayudu, D. Marthappa Kini, T. Mohan Rao, B. K. Mohan Rao, M. Mohammad Fasiuddin. Mukundan, M. Nagaratnam, A. K. Narasinga Rao D. Narayanan, P. Pinto B. M. Purushotam, K Ramalingam, V. Ramanna, V. Ramanujam D. Rama Rao, D. Sankarasubrahmanyam, T. K. Santhanam, K. Seshadri, C. K. Seshu Ayyar, K. A. Shaik Hussain. Shanmuga Nainar, T. P. Sivaswami, E. G. Somasundaram, T. Srinivasan, K. V. Subrahmanyam, P. K. Suryanarayanan, J. V. V. Thothadri, P. Varisai Muhammad. Viswanatham, S.

Class II. Anantanarayanan, T. N. Ganeshsunder Rao, H. Hariharan, S. V. Khader Razaack. Krishnakumar, H. Krishnananda Sastri, S. Lakshminarayana, S. Mahadeva Ayyar, S. Parthasarathi, A. V. Pichumani, A. V. Raghottam Reddy J. Sattanathan, R. S. Sundararaman, S. Syed, P. K. Tobias, K. I. Venkatachalamayya Sastri, K. Venkayya, N. *Readmitted.* Vaithianathan, S. Narasimham, Y. B. Venkateswara Rao, P.

The following candidates have reference in the subjects mentioned.

III Year. Achanna Sastri, Agricultural Botany. Gitachari, Ref. in F. M. and Economics. Joseph Moncy, Farm Management & Economics. Krishnanunni Nayar, M., Farm Management & Economics. Narayana Nambiar, K. T., Agricultural Chemistry. Satyanarayanamurti, K. Agrl. F. M. & Economics. Shanmugasundaram, Farm Management & Economics. Shivasankar Rao, G, Farm Management & Economics.

II Year. Adiseshayya Herbert, Zoology. Brahmayya, G. V, Zoology and Animal Hygiene Gopalakrishna Kamath, Zoology. Rajagopalan, P. V., Ag. Engineering. Brahmayya, C. V., Zoology & Animal Hygiene. Sathianathan, S., Agl. Plant Husbandry. Srinivasamurti, Agl. Engineering. Sivaraman, Agrl. Plant Husbandry & Agrl. Engineering.

* Passed in the final examination but not eligible for the degree.

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Editorial.

King's Birth Day Honours. We are glad to note that the title of Rao Sahib has been conferred on Mr. C. Narayana Ayyar, Head Quarters Dy. Director of Agriculture. He has been connected with the Madras Department of Agriculture for well over 30 years. His services has been mainly in the districts with the exception of a few years when he was in the Agricultural College, first as an Assistant in Entomology, and later as Lecturer in Agriculture. He is one of the earliest members of the Union and during his stay in Coimbatore has been the Editor of our journal for a period. Among his various activities his pioneering work in connection with rice improvement work in Tanjore District is still remembered in the tract. The recognition of his work has come none too soon as he is due to retire from service next November. On behalf of the Union we offer Mr. Narayana Ayyar our sincere congratulations.

It is with great pleasure we notice that Dr. Shaw, Agricultural Expert to the Imperial Council of Agricultural Research has been awarded the title of C. I. E. His services has mostly been in the Imperial Institute of Agriculture, Pusa, where starting as a Mycologist he was later appointed Imperial Economic Botanist, and finally as the Director of the Institute. His wide experience in Pathological and Breeding problems, had been very fruitful in evolving disease-resistant types of crops amongst which may be mentioned the famous wilt-resistant types of *arhar*.

We are also glad to note that the title of Rao Sahib has been conferred on Messrs. Thadani, Economic Botanist, Sind, and Bal, Agricultural Chemist, Nagpur, two other Agricultural Officers in India. We offer our hearty congratulations to the above three gentlemen.

WEIGHT OF CALVES AND PERIOD OF GESTATION IN SOME INDIAN BREEDS OF CATTLE

BY R. W. LITTLEWOOD, N. D. A.

Weight of calves. In the Live-stock section of the Madras Agricultural Department, the calves borne in the different herds are weighed at birth and the present note is the result of the analysis of the records of the weights of calves at birth for the past 11 years in the herds of (1) Kangayam (2) Sind (3) Ongole.

Sex and weight of calf. In all the above three herds, it is found that the weight of calf is significantly higher for the bull calf than for the heifer calf. Table 1 summarises the results obtained both by the method of comparison of the means for the two sexes with their respective standard errors and also by the method of $2 \times n$ classification (Fisher's).

Table I. *Sex and weight of calf.*

Mean weights of calf.				Alternative method.	
Breed	Bull	Heifer	Deviation S. E. D.	X 2	P = ·05
Kangayam	44·6±·41	41·4±·35	5·87	52·5	28·869
Ongole	62·0±·67	57·7±·53	5·00	57·9	30·144
Sind	44·9±·47	41·7±·52	4·57	27·1	26·296

The increase in the mean weight of bull calf over the heifer is significant, indicating that sex has an influence.

In addition to the above general indication, it is seen from table I that in the Ongole herd, the average weights of calves in both the sexes are considerably higher than in the other two breeds, Kangayam and Sind.

It is quite probable that it may be the characteristic of the Ongole breed that the calves at birth are well developed, but the figures in Table II showing the weight of calves at birth in the same breed born for the same bulls, but from cows bred in different stations as Chintaladevi and Hosur, show clearly the influence of locality.

Table II.

	Chintaladevi.				Hosur.			
			Average weight.				Average weight.	
Bull No.	Bull calves No.	Heifer calves No.	Bull calf.	Heifer calf.	Bull calves No.	Heifer calves No.	Bull calf.	Heifer calf.
			lb.	lb.			lb.	lb.
6	18	25	69·3	60	12	9	50	46
14	3	1	66·0	62	20	8	62	54
31	3	5	58·3	58	13	16	60	53

As regards the management of the stock in both places, the feeding of the stock was similar for concentrated rations but for forage, the Chintaladevi stock received cholam straw grown on the farm and the Hosur received spear grass hay. The analysis of soils in both the

places (Table III a and III b) show that the lime content of Hosur soil is definitely poor when compared with Chintaladevi soil.

Hosur Livestock Research Station.

Composition of soils of paddocks from which samples were drawn.

Table III. a.

	Paddock No.			
	3	35	32	38
Lime as Cao	0·14	0·28	0·28	0·11
Total Potash	0·23	0·45	0·31	0·15
Available Potash	0·024	0·010	0·020	0·013
Total Phosphoric acid	0·05	0·05	0·04	0·04
Available Phosphoric acid	0·0016	0·0019	0·0045	0·0086
Nitrogen	0·042	0·072	0·074	0·057

Generally the four paddocks were poor in lime and phosphate; Nos. 3 and 38 in nitrogen in addition.

Table III. b.

Chintaladevi Livestock Research Station The following are the results of analyses of four soil samples from the Livestock Research Station, Chintaladevi—1924.

	Black soil.		Red soil.	
Loss on ignition	4·45	6·42	6·40	3·97
Insoluble mineral matter	81·60	75·26	67·79	81·47
Iron Oxide (FeO_3)	3·81	4·57	5·87	4·74
Alumina (Al_2O_3)	4·02	8·41	11·45	7·80
Lime (CaO)	3·29	2·50	4·18	0·44
Magnesia (MgO)	0·53	0·41	0·21	0·43
Phosphoric acid (P_2O_5)	0·029	0·025	0·025	0·019
Potash (K_2O)	0·22	0·29	0·73	0·49
Soda (Na_2O)	0·51	0·38	0·37	0·46
Sulphuric acid (SO_3)	0·12	0·067	0·076	0·074
Carbonic acid (CO_2)	2·38	2·26	3·00	Trace
Nitrogen (N)	0·023	0·027	0·033	0·038
Available phosphoric acid (P_2O_5)	0·0054	0·0066	0·0005	0·0014
Available potash (K_2O)	0·0059	0·0069	0·0029	0·009

The following are the details regarding the sex and weight of calf in the different herds.

Kangayam Herd. 531 calves have been born to 16 different bulls, of which 274 were heifers and 257 bull calves. The average weight of these calves works out to 45·2 lb. for a bull and 41·7 lb. for a heifer, the highest weight being 62 lb. both for a bull and heifer calf and the lowest weight 25 lb. for a bull and 21 lb. for a heifer calf.

One bull produced 47 calves, the average weight of the calves being bulls 49·6 lb. and heifers 45·5 lb. Some bulls produced more heifer calves than bull calves and vice versa; bull No. 35 has 43 bulls and 73 heifer calves to his credit whereas No. 132 has 25 bulls and 11 heifers.

Sind Herd. 15 different bulls have produced 277 calves of which 140 are heifers and 137 bull calves. The average weights of these are bulls 45 lb. heifers 41·5 lb. The highest weight for a bull calf is 66 lb. and for a heifer 56 lb. the lowest weights being bull 26 lb. and heifers 27 lb.

The Bull No. 118 produced 24 calves, the average weights being bulls 51 lb. and heifers 43 lb.

Bull No. 8 has produced 18 heifer calves and 6 bull calves and No 38 has 11 heifers and 4 bull calves to his credit whereas Bull No. 115 has produced 15 bull and 7 heifer calves.

Ongole Herd. Chintaladevi Farm:— 248 calves were born to 9 bulls of which 120 were bull and 128 heifer calves. The average weight works out to 65 lb. for bull calves and 59·5 lb. for heifer calves. The highest weight for a bull calf is 83 lb. and for a heifer 84 lb. the lowest being, bull calf 34 lb. and heifer calf 38 lb.

Bull No. 8 has produced 72 calves, 40 of which are heifers and bull No. 125 produced 37 calves, 21 of which are bulls and 16 heifers.

43 calves were born to Bull No. 6 18 bull calves averaged 69·3 lb. each and 25 heifer calves 60 lb. each.

Hosur Farm. 10 Ongole bulls produced 199 calves of which 109 were bulls and 90 heifer calves. The average weight works out to bulls 60·3 lb. and heifers 54 lb. the highest weights recorded being bull calf 80 lb. heifer calf 84 lb.

Bull No. 14 produced 28 calves, 20 of which are bull and 8 heifer calves.

20 calves were born to one bull, of which 11 bull calves average 63 lb. and 9 heifers 59·5 lb. each.

Period of gestation in cows. Breeders generally accept the average period of gestation of cows as 285 days; if a cow goes longer than this, their opinion is that the calf will most probably be a bull calf. The writer has gone through his records and worked out the average period of gestation in cows of the Ongole, Kangayam and Sind breeds. The breeder's acceptance of 285 days gestation period holds good for most cows of the Kangayam and Sind breeds, but not for the Ongoles. For some unknown reason the period of gestation for Ongole cows is 3 to 4 days longer on the average than the two former breeds.

There were cases in all the 3 breeds where some cows calved earlier than 277 days and some over the 300 days periods but these have been omitted.

Table IV. *Sex and period of gestation.*

Mean period of gestation.				Alternative method.	
Breed.	Bull.	Heifer.	Deviation S. E. D.	X2	P = ·05
Kangayam	286·6±·30	284·1±·26	6·65	57·33	35·172
Ongole	289·8±·32	288·5±·30	2·80	33 46	36·415
Sind	286·3± 41	284·5±·38	3·00	36·17	35·172

Table IV shows for the Ongole in the period of gestation for cows (a) a significant increase in both the heifer and bull calves born (b) sex of calf has also a significant relationship with the period of gestation.

I wish to thank Mr. K. Ramiah, Paddy Specialist, for his kind assistance in working out the results statistically.

THE RELATION OF SOME PLANT CHARACTERS TO YIELD IN CUMBU—*PENNISETUM TYPHOIDES* (Burm.) Stapf and Hubbard—THE PEARL MILLET

BY

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The present study deals with the relationships that subsist between grain yield and some other metrical characters of the Pearl Millet (*Cumbu*, Tamil; *Sajja*, Telugu; and *Bajri*, N. India).

The following six rainfed varieties representative of some distinct types in the Pearl Millet were chosen for study in 1932. The measurements were repeated in 1933.

Selection No.	Population	
	1932	1933
P. T. 17—G.	130	130
P. T. 17—P.	120	85
P. T. 72	130	130
P. T. 248	110	130
P. T. 331	130	130
M. S. 1354	110	125

In Table I are presented the correlation co-efficients between (a) the total grain yield of a plant and (1) height of plant, (2) number of nodes on the main axis, and (3) total number of earheads, and (b) the correlations between the total number of earheads and the average yield per earhead. These are given for both the years.

In the second year of this work, the correlations between the main earhead characters were also studied. Table II presents the correlations between (1) the yield of the main earhead and (2) surface area of the earhead, (3) diameter of the peduncle of the main axis, (4) height of the main axis, (5) length of the earhead, (6) diameter of the earhead, (7) length of the peduncle of the main axis, (8) total number of earheads, and (9) average yield per earhead. The suffix of r used in presenting the partial correlations is as numbered in the list enumerated above.

In order that the significance of the r-values may be readily judged, the correlation co-efficients for the ·01 level of significance are entered throughout by finding $\frac{t}{\sqrt{n-2+t^2}}$ where n is the number of

observations and t (Fisher's t) corresponding to P='01 is obtained from Table XXXV of G. W. Snedecor's 'Analysis of Variance' (1934).

Tests were made to see whether the same degree of correlation exists between the variates (a) in the same variety between two years, (b) between all the varieties in each year, and (c) between all the varieties in both the years. These tests are presented in Table III. z is the hyperbolically transformed r and $\sigma_{z \sim z'}$ the standard error of $z \sim z'$ (L. H. C. Tippett, 1931, the Methods of Statistics, p. 140). From columns 2 to 7 it is evident that the fluctuations of r between 2 years in the same variety are in most cases within the limits of errors of random sampling. X_1^2 and X_2^2 relate to the fluctuations (Tippett, p. 142) of r between all the varieties in 1932 and 1933 respectively, and X^2 relates to all the varieties in both the years. When P for X^2 is above '05 the corresponding mean value of r is entered by transforming $\bar{z}$ to $\bar{r}$; likewise for X_1^2 and X_2^2.

Relation between the Total Grain Yield of a Plant and Some Other Characters. *Total grain yield and height.* The height of a plant is taken as the height of the main axis measured from the soil level to the tip of the earhead. The variations of r between the varieties in each year are beyond the limits of errors of random sampling. (Table III). In no case is the r value high, though significant. The mere height of a plant gives little indication of its capacity to yield well.

Total grain yield and the number of nodes. The number of nodes (and these mean leaves) is reckoned on the main axis. The fluctuations of r are not significant (Table III). z = '20 is significant, the standard error being '03. However, this value is too low to consider the number of nodes as of importance in estimating the total grain yield.

Total grain yield and the total number of earheads. In 1932 the r-values fluctuate widely but not in 1933 (Table III). The correlation coefficients are fairly high throughout. A plant with a large number of earheads is to be preferred though the total number of earheads is negatively correlated with the average yield per earhead (Table I).

An estimate of the total grain yield can be made when in addition to the total number of earheads being known an estimate of the average yield per earhead is possible. It was therefore thought fit to explore the possibility of any single earhead giving an indication of the average yield per earhead, and the main earhead which is a convenient fixture was chosen for this study. It was found that the yield of this main earhead is correlated with the average yield per earhead (Table II). For this reason attention was directed to investigate the factors that contributed to the yield of the main earhead.

Relation between the yield of the main earhead and some other characters. *Main earhead yield and the total number of earheads.* The main earhead yield is independent of the total number of earheads

produced on a plant. The corresponding correlations are (except in one case) below the level of significance (Table II).

Main earhead yield and its surface area. The inflorescence of this millet is a terminal compound spike. The grains are borne on rachillae disposed round an unbranched rachis in a seriate arrangement. A ripe earhead presents the appearance of grains packed on a surface almost cylindrical about the rachis. The surface area of the earhead can be taken approximately as being proportional to dl, d being the diameter and l the length of the earhead. It is seen from Table III that all the correlation coefficients can be combined and the improved estimate of r is ·67. The partial correlations obtained by eliminating the effect of the thickness of the peduncle and the height of the main axis, the two factors which bear some relation to yield, are considerable (Table IV).

Main earhead yield and the length and the diameter of the earhead. The yield is correlated with the length and the diameter of the earhead, these being the dimensions determining the surface area. It is found from Table III that in both cases the several values of r can be combined, $\bar{r}_{15}$ = ·53 and $\bar{r}_{16}$ = 52. These two factors supply more information when combined to derive the surface area, than singly.

Main earhead yield and the length and the diameter of the peduncle. The length of the peduncle of the main axis is the distance between the topmost node and the base of the earhead. The diameter of the peduncle was measured with Vernier callipers at a standard distance of 5 cm. below the base of the spike. Table III shows that in both cases the r's can be combined. $\bar{r}_{17}$ = ·20 is just above the level of significance but not high enough to consider the length of the peduncle as an index to yield. $\bar{r}_{13}$ = ·64 showing that a thick peduncle is a mark of high yield. The partial correlations obtained by eliminating the effect of the surface area are smaller than those obtained by eliminating the effect of height (Table IV). The high correlation between the peduncle thickness and yield is due to the close relationship subsisting between the peduncle thickness and the surface area which has a direct relation with yield.

Main earhead yield and the height of the main axis. The correlations between the main earhead yield and the height of the shoot bearing this earhead fluctuate from variety to variety (Table III). The correlations are significant but generally not high enough to rely on this factor by itself as a guide to yield.

Multiple Correlation Coefficients. The multiple correlation coefficients between the yield of the main earhead and the surface area of the earhead, the thickness of peduncle and the height of the main axis (the three factors that were worth pursueing) are given in Table V. The table commences with r_{12} because of the direct relation that surface area has with yield. The R-values for the ·01 level of significance are

entered by taking $\sqrt{\frac{me^{2z}}{N-m-1+me^{2z}}}$ where m is the number of independent variates, N the size of the sample, and e^{2z} corresponding to $n_1 = m$ and $n_2 = N - m - 1$ is obtained from Table XXXV of Snedecor's 'Analysis of Variance.' Throughout, $R_{1\cdot234}$ is significantly above r_{12}. The tests of significance presented in Table VI were carried out by considering P corresponding to

$$z = \frac{1}{2} \log_e \frac{(R^2_{1\cdot234} - r^2_{12})(N-4)}{2(1-R^2_{1\cdot234})}$$

for degrees of freedom $n_1 = 2$ and $n_2 = N - 4$ (Tippett 1931, p. 208). It is concluded that the additional factors namely the thickness of peduncle and the height of the main axis help to predict the grain yield of the main earhead with a greater precision than is possible with a knowledge of the surface area only.

Summary. The correlations between the total grain yield per plant and the height of the main axis, the number of nodes in it, and the total number of earheads were determined in six rainfed varieties of the Pearl Millet in two years. The number of heads is correlated with yield. The other factors are but slightly correlated. The average yield per head is correlated to the yield of the main earhead. The yield of the main earhead is correlated with the length, the diameter and the surface area of the earhead, the thickness of peduncle, and the height of the main axis, while the length of the peduncle bears no correlation to yield.

Partial and multiple correlations were also calculated. The yield of the main earhead can be predicted with a fair amount of certainty when the surface area of that earhead, the thickness of its peduncle, and the height of its axis, are known.

Table I.

Total correlation coefficients.

Correlates	P. T. 17/G		P. T. 17/P		P. T. 72		P. T. 248.		P. T. 331		M. S. 1354	
	1932	1933	1932	1933	1932	1933	1932	1933	1932	1933	1932	1933
Total grain yield and height	·30	·08	·30	·27	·53	·36	·27	·29	·59	·41	·41	·09
" " number of nodes	·19	·11	·20	·07	·14	·36	·08	·16	·44	·14	·20	·13
" " number of ear-heads	·69	·69	·65	·71	·46	·73	·51	·80	·59	·72	·83	·70
Number of ear-heads and average yield per ear-head	−·60	−·59	−·56	−·62	−·59	−·44	−·63	−·46	−·27	−·37	−·35	−·55
Level of significance (P=·01)	·23	·23	·23	·28	·23	·23	·25	·23	·23	·23	·25	·23

Table III.

Combination of the correlation co-efficients.

Correlates.	$\frac{z \sim z'}{\sigma_{z \sim z'}}$ z for 1932, z' for 1933						All the varieties in 1932		All the varieties in 1933		All the varieties in 1932 & 1933	
	P. T. 17-G	P. T. 17-P.	P. T. 72.	P. T. 248.	P. T. 331.	M.S. 1354.	X_1^2	$\bar{r}$	X_2^2	$\bar{r}$	X^2	$\bar{r}$
1	2	3	4	5	6	7	8	9	10	11	12	13
Total grain yield and height	1·75	·21	1·35	·15	1·43	2·42	17·04	...	13·82	...	42·39	...
" number of nodes	0·64	·90	1·75	·61	2·39	0·53	11·05	·22	7·20	·17	19·14	·20
" number of earheads	...	·76	2·15	4·12	1·04	0·98	34·51	...	5·10	·73	51·14	...
Number of earheads and average yield per earhead ...	0·08	·69	1·20	1·83	0·80	1·51	21·97	...	9·78	-·59	31·75	...
Main earhead yield and surface area of earhead ...	...	...	...	...	...	...	...	...	6·24	·67	...	...
" diameter of peduncle	...	...	...	...	...	...	...	...	2·31	·64	...	...
" height of main axis	...	...	...	...	...	...	...	...	27·98	...	...	...
" length of earhead	...	...	...	...	...	...	...	...	7·44	·53	...	...
" diameter of earhead	...	...	...	...	...	...	...	...	3·86	·52	...	...
" length of peduncle	...	...	...	...	...	...	...	...	9·81	·20	...	...
" number of earheads	...	...	...	...	...	...	...	...	6·50	·11	...	...
" average yield per earhead ...	...	...	...	...	...	...	...	...	22·32	...	...	...
							P = ·05, X_1^2 = 11·07		P = ·05, X_2^2 = 11·07		P = ·05, X^2 = 19·68	

Table II.

Total correlation co-efficients.

Main earhead yield and other factors.

Correlates.	P. T. 17-G	P. T. 17-P	P. T. 72	P. T. 248	P. T. 331	M. S. 1354
Main earhead yield & surface area of earhead.	·66	·69	·74	·69	·57	·65
" " diameter of peduncle.	·69	·58	·65	·62	·63	·61
" " height of main axis.	·37	·48	·55	·61	·76	·46
" " length of earhead.	·51	·57	·44	·60	·45	·62
" " diameter of earhead.	·48	·56	·59	·44	·53	·55
" " length of peduncle.	·19	·05	·12	·10	·36	·31
" " number of earheads.	– ·10	– ·17	– ·07	– ·06	– ·01	– ·29
" " average yield per earhead.	·67	·67	·67	·72	·84	·58
Level of significance (P = ·01).	·23	·28	·23	23	·23	·23

Table IV.

Partial correlation coefficients.

Main ear-head yield and other factors.

r	P. T. 17/G.	P. T. 17/P.	P. T. 72	P. T. 248	P. T. 331	M. S. 1354
r_{12}	·66	·69	·74	·69	·57	·65
r_{13}	·69	·58	·65	·62	·63	·61
r_{14}	·37	·48	·55	·61	·76	·46
Level of significance (P = ·01)	·23	·28	·23	·23	·23	·23
$r_{12\cdot3}$	·39	·54	·56	·49	·27	·42
$r_{12\cdot4}$	·61	·65	·65	·59	·37	·57
$r_{13\cdot2}$	·59	·31	·36	·31	·41	·34
$r_{13\cdot4}$	·66	·43	·58	·54	·54	·56
$r_{14\cdot2}$	·20	·39	·40	·45	·68	·29
$r_{14\cdot3}$	·24	·25	·45	·53	·71	·37
Level of significance (P = 01)	·23	·28	·23	·23	·23	·23
$r_{12\cdot34}$	·36	·56	·49	·40	·09	·35
$r_{13\cdot24}$	·59	·17	·35	·31	·42	·33
$r_{14\cdot23}$	·17	·29	·39	·45	·68	·29
Level of significance (P = ·01)	·23	·28	·23	·23	·23	·23

Table V.

Multiple correlation coefficients.

Main earhead yield and other factors.

R	P. T. 17-G	P. T. 17-P	P. T. 72	P. T. 248	P. T. 331	M.S. 1354
r_{12}	·66	·69	·74	·69	·57	·65
$R_{1\cdot23}$	·79	·73	·78	·73	·67	·70
$R_{1\cdot24}$	67	·75	·78	·77	·80	·69
$R_{1\cdot34}$	·71	·61	·73	·74	·84	·67
Level of significance (P = ·01)	·27	·33	·27	·28	·28	·27
$R_{1\cdot234}$	·80	·75	·79	·79	·84	·73
Level of significance (P = ·01)	·29	·36	·29	·29	·29	·30

Table VI.

Tests of significance of the difference between $R_{1.234}$ and r_{12}.

Selection.	$z_{1.234-12}$	Degrees of freedom.		P
		n_1	n_2	
P. T. 17-G	1·68	2	126	< 0·01
P. T. 17-P	1·08	2	126	< 0·01
P. T. 72	1·30	2	126	< 0·01
P. T. 248	1·60	2	81	< 0·01
P. T. 331	1·63	2	126	< 0·01
M. S. 1354	1·31	2	121	< 0·01

THE TOBACCO TRADE OF MADRAS,—PART I.

BY C. V. SARVAYYA, B.Sc., Ag.,
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Introduction. In the solution of marketing problems in the different crops, the study of the existing trade with special reference to general world position occupies an important part. With the exception of United States of America, India is the largest producer of tobacco (1000 million lb.) in the world. In the production of tobacco of commerce, Madras occupies the premier position among the provinces. In response to the preference for Empire tobacco accorded in 1919 and subsequently in 1925 there has been a corresponding increase in acreage and production, though not in the quality of the product, the character for which this commodity is most valued; consequently India has not derived as much benefit out of the preference as was expected. As the balance of trade in tobacco is unfavourable consideration of the external trade in this commodity with other countries requires earlier attention than that of the internal trade.

The imports of the following countries given below indicate the magnitude of the demand for tobacco. Quinquennial averages for such purposes are preferred to a single annual import figures from the consideration of peculiarities of the trade in this commodity.

Table I. *Imports of Principal Countries in million lb.*

Importing Countries.	Average of 1925—'29.	1930.
Germany	218	235
United Kingdom	203	223
China	105	124
France	92	155
Netherlands	70	70
Spain	54	57
Belgium	45	49
Czecho Slovakia	39	23
Poland	34	42
Austria	31	22
Argentina	24	23
Australia	22	20

Canada	17	17
Egypt	17	16
Italy	16	12
Switzerland	13	17
Japan	13	10
Sweden	12	10
Denmark	12	14
Irish free state	9	12
Finland	7	10
Norway	5	5
Total ...	1058	1166

The figures of production and exports of the principal producing countries disclose the probable competitors in the market.

Table 2. *Production and export in million lb.*

Country.	Production. 1930—'31.	Exports. 1925—29	Exports. 1930	Remarks.
United States of America	1635	525	580	* Figures for production not available.
Dutch East Indies*	—	170	131	
Greece	153	109	108	
Brazil*	—	68	81	
Bulgaria	53	57	49	
Philippine Islands	102	48	50	
Cuba	82	42	59	
British India	1404	40	39	
Dominion Republic*	--	36	28	
Algeria	43	34	26	
Paraguay*	—	14	—	
Hungary*	—	12	23	
Russia	305	10	20	
Yugoslavia*	—	5	3	
Ceylon*	—	2	1	

The above figures indicate that India occupies the 8th rank in the magnitude of exports, a place not at all commensurate with its 2nd rank in the list of production. In India Madras ranks first in the production of tobacco of commerce.

External Trade (a) *Exports.* The exports of Indian tobacco to foreign countries and the share of Madras therein are examined with reference to the rebate of import duty. The quinquennial periods of 1914—15 to 1918-19, 1921—22 to 1925—26 and 1926—27 to 1930—31 are selected for elucidating the effect of the different amounts of rebate of import duty on Empire tobacco into United Kingdom. The first quinquennium represents the pre-preference period, the second the period of 1/6 rebate and the third the period of 1/4 rebate of import duty.

The total export trade of India in tobacco rose up from Rs. 56 to 110 laks from the first to the third period; and the share of Madras which once formed only one seventh of the total exports (i.e. Rs. 9 lakhs) has now risen to over half of the exports (Rs 56 lakhs). The quantity and cost of exports given in table 3 indicate the growth in the value of exports and the share of Madras therein.

Table 3. *Share of Madras in the Tobacco Trade of India.*

Period.	Manufactured.		Manufactured.					
			Cigars.		Cigarettes.		Other sorts.	
	Quantity in 1000 lb.	Cost in Rs. 1000.	Quantity in 1000 lb.	Cost in Rs. 1000.	Quantity in 1000 lb.	Cost in Rs. 1000.	Quantity in 1000 lb.	Cost in Rs. 1000.
Pre-preference	24045	4155	1260	1125	175	230	415	115
Share of Madras.	2961	630	502	302	—	—	35	25
1/6 rebate.	31581	9072	369	422	60	72	701	301
Share of Madras.	9106	3166	94	118	48·1	53	61	49
¼ rebate.	28769	10290	266	292	288	280	495	133
Share of Madras.	14085	5242	67	78	280	271	12·1	5·4

Though the quantity of unmanufactured tobacco exported remained constant the value had risen from 41 to 102 lakhs in spite of the fall in the price per pound of tobacco. It is therefore evident that there is vast improvement in the quality of the produce. The share of Madras increased from 6 to 52 lakhs. There is a decline in the cigar trade from 11 to 2 lakhs owing to the fact that the cigarette has gained favour since the war, the end of pre-preference period. Though an increase is indicated in the cigarette trade, the cost of the total Indian Exports has not increased much, while the participation therein of Madras has tantamount identified itself with the total exports.

Tobacco Unmanufactured. In the demand for unmanufactured tobacco it is found that the British Empire takes a major portion of the exports and that other foreign countries have very unsteady demands for Indian tobacco. France, in the pre-preference period and Germany in the 1/6 rebate period have shown some attention to Indian tobacco while Japan and Netherlands have been regularly purchasing a fairly large quantity of their requirements from India since the institution of the rebate. Among the British Empire, the United Kingdom, Aden and Dependencies, Straits Settlements, Hongkong and Federated Malay States come in the order of their purchases of Indian tobacco. It is interesting to note the growth of their purchases given in table 4.

Table 4.

Quantity of Exports to British Empire Countries. (*In million lb.*).

Country.	Period		
	Pre-preference.	⅙ rebate.	¼ rebate.
United Kingdom	3·0	5·6	10·0
Aden and Dependencies	5·6	4·9	5·9
Straits Settlements	2·2	3·7	3·6
Hongkong	1·9	2·8	1·7
Federate Malay States	—	1·2	1·5
Total British Empire	14·5	20·5	22·6
Total Indian Exports of Un-manufactured tobacco	24·0	31·5	28·8

We will next proceed to examine the needs and requirements of each of the importing countries.

United Kingdom. Barring Germany, United Kingdom is the largest tobacco market in the world. With the increase in the consumption of tobacco per capita and with the change in the method of usage from the pipe to the cigarette since the Great-war, the kind and quality of tobacco required for this market are different from what they were before. Tobacco suited to cigarette manufacture is in greater demand than the pipe and cigar tobaccos which have a fairly good position. Of the total purchases of 200–225 million pounds of leaf, 160–180 million pounds are obtained from United States of America. Against such a large quantity, purchases from India figuring to the extent of only 10 million pounds cut a very poor figure considering the Indian production of leaf and the rebate of import duty on Empire tobaccos. The bright flue cured tobacco from the Virginia Carolina belts is largely purchased.

Of the Indian Exports, only about 10 to 15 percent is fit for use in cigarettes, while the rest is used for pipes. Most of the tobacco of Madras is raised on heavy clay soils of Guntur etc., which give heavy 'body' to the leaf. Very little is produced on the sandy loams resembling those of Virginia and Carolina and as such the prospect of most of the Indian flue cured leaf to participate in the cigarette tobacco trade of United Kingdom is not yet near at hand.

Other Countries. Japan and Netherlands are the only two countries which purchase a fairly large quantity of tobacco from India. The requirements of the former is of two-fold nature, one, for the preparation of cigarettes suitable for home consumption and for re-export to India, and two, for exporting to China after the necessary treatment. Netherlands purchase leaf suitable for cigars.

Tobacco Manufactured Cigars. The export of cigars has dwindled from about 1¼ million pounds to a ¼ million pounds and Straits Settlements used to be the chief customer, Madras supplying nearly half the demand.

Table 5. *Quantity of Exports in million lb.*

Country.	Period.		
	Pre-preference.	1/6 rebate.	¼ rebate.
Straits settlements.	1·05	0·19	0·14
Total Indian Exports.	1 26	0·37	0·27
Share of Madras.	0 50	0·09	0·07

Burma is one of the chief competitors in this trade. Owing to the settling of Indians permanently in Straits Settlements the particular kind of Cigar-makers also found greater employment there. Since then she had reduced her purchases of manufactured cigars, while she increased her purchases of unmanufactured tobacco for local manufacture of cigars.

Tobacco Manufactured Cigarettes. Trade in this form of export is of recent origin and of very little quantity as compared to

other forms of export, Ceylon is the chief purchaser and Madras is the largest supplier.

Table 6. *Quantity of Cigarettes (in 1000 lb.)*

Country.	Period.	
	1/6 rebate.	¼ rebate.
Ceylon.	47	206
Total Indian Exports.	60	288
Share of Madras.	48	280

(b) *Imports.* The imports have improved in more than one direction. The rise in the imports of unmanufactured tobacco is about 15 times what it was in the pre-preference period, while the rise in the import of unmanufactured cigarettes is only twice the imports in the pre-preference period. The reason for this is obvious as there is at present larger manufacture in India of cigarettes from leaf imported from foreign countries.

Table 7. *Quantity of Indian Imports in 1000 lb.*

Form of Import.	Period.		
	Pre-preference	⅙ rebate	¼ rebate
Unmanufactured	325	3765	4522
Share of Madras	118	2018	2406
Manufactured—Cigars	53	29	35
Share of Madras	0·9	0·4	0 26
Manufacturad Cigarettes	2623	3288	4573
Share of Madras	167	231	402
Other sorts	640	306	268
Share of Madras	30	223	19

In the imports of unmanufactured tobacco into India over 95 per cent. is from United States of America. The leaf from United States of America is considered to be superior in all the qualities required for the manufacture of high class cigarettes. Similarly over 96 per cent. of the imports of Cigarettes, and tobacco for pipes and cigarettes is from United Kingdom.

III. Tariff and Protection. All forms of tobacco imports are taxed. The tariff on imported tobacco has been Rs. 2 per pound and ¼ rebate (Rs. 0—8—0) was accorded since 1926 for leaf from British colonies. This was originally programmed to be in effect for 10 years. The budget 1934—35 has passed increased taxation to Rs. 2—6—0 per pound (Standard) and Rs. 1—14—0 preferential. Cigarettes cost not exceeding Rs. 10—8—0 per 1000 have been taxed at Rs. 8—8—0 per 1000 and those cost exceeding above Rs. 10—8—0 have been taxed at Rs. 12 per 1000. This however was somewhat protective to the cigarette industry of India. But in 1934—35 this has been changed to Rs. 5—15—0 per 1000 cigarettes plus 25 per cent *ad valorem.* This change has been proposed by the Finance Member Sir George Schuster as he felt that the heavy duty existing prior to 1934—35 on cigarettes had adversly effected the imports and reduced the revenue. He felt

that the cigarettes made wholly or mainly of Indian leaf" has always enjoyed the shelter of a somewhat heavy revenue duty on the imported commodity. He said " My remarks relate to a very important trade that exists in this country in a type of cigarettes which even when made in India are made exclusively or almost exclusively from imported tobacco and experience indicates that we have not adjusted probably the relation between the import duty on raw leaf and the import duty on finished article. Under our present tariff, the duty on cigarettes works out at *something like* double the duty on the tobacco used in making similar cigarettes in India, and the result has been to divert the manufacture of the great majority of the leading brands of cigarettes to factories in India belonging to the same interests as previously imported these brands from abroad ". The results of the alteration is very serious and significant on its effect as can be observed from table 8.

Table 8.

Level of price of cigarettes per 1000.	Prior to 1934-35.			From 1934-35.				Difference between column No. 4 & 8.	Remarks.
	Cost.	Duty.	Total.	Cost.	25% advalorem.	Duty.	Total.		
1	2	3	4	5	6	7	8	9	10
Cigarettes—Cost not exceeding Rs. 10/8 per 1000.									* Cost of some of the cheapest Cigarettes manufactured in India.
Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
1 0 0	1 0 0	8 8 0	9 8 0	1 0 0	0 4 0	5 15 0	7 3 0	-2 5 0	
1 4 0*	1 4 0	8 8 0	9 12 0	1 4 0	0 5 0	5 15 0	7 8 0	-2 4 0	
5 0 0	5 0 0	8 8 0	13 8 0	5 0 0	1 4 0	5 15 0	12 3 0	-1 5 0	
10 0 0	10 0 0	8 8 0	18 8 0	10 0 0	2 8 0	5 15 0	18 7 0	-0 1 0	
10 4 0	10 4 0	8 8 0	18 12 0	10 4 0	2 9 0	5 15 0	18 12 0	Nil.	
10 8 0	10 8 0	8 8 0	19 0 0	10 8 0	2 10 0	5 15 0	19 1 0	+0 1 0	
Cigarettes—Cost exceeding Rs. 10/8 per 1000.									
10 10 0	10 10 0	12 0 0	22 10 0	10 10 0	2 10 6	5 15 0	19 3 6	-3 6 6	
15 0 0	15 0 0	12 0 0	27 0 0	15 0 0	3 12 0	5 15 0	24 11 0	-2 5 0	
20 0 0	20 0 0	12 0 0	32 0 0	20 0 0	5 0 0	5 15 0	30 15 0	-1 1 0	
24 4 0	24 4 0	12 0 0	36 4 0	24 4 0	6 1 0	5 15 0	36 4 0	Nil.	
24 8 0	24 8 0	12 0 0	36 8 0	24 8 0	6 2 0	5 15 0	36 9 0	+0 1 0	
30 0 0	30 0 0	12 0 0	42 0 0	30 0 0	7 8 0	5 15 0	43 7 0	+1 7 0	

It is therefore obvious that the difference between the duty prior to 1934-35 and that from 1934-35 per 1000 together with advalorem becomes a minimum at a cost of Rs. 10-4-0 per cheap cigarettes and Rs. 24—4-0 for costly ones. Though he felt and meant that the cheap cigarette made wholly or made mainly in Indian leaf has always and should also in future continue to enjoy the shelter of a heavy revenue duty on the imported commodity, the change in the tariff existing prior to 1934-35 to what is experienced now, frustrates the above object and is by no means an insiduous one. The cheap cigarette of Indian manufacture has been dealt a blow and the costly imported cigarette has been given a pat and even the erstwhile manufacture of costly cigarettes in India almost exclusively from imported

tobacco has been threatened with ruin. The reasons are not far to seek. India imports every year about 4·5 million pounds of unmanufactured leaf costing only Rs. 37 lakhs, over 95 per cent. of which is from United States of America, and 4·7 million pounds of cigarettes, costing about Rs. 1·9 crores, over 96 per cent. of which is from United Kingdom.

The increase in duty on unmanufactured tobacco, by restricting the imports of fine flavoured leaf, acts detrimentally on Indian manufacture of Cigarettes as such leaf is undoubtedly required for purposes of blending. The above duty coupled with the lowering of import duty on costly cigarettes, favouring larger imports of cigarettes into India, stifle the growing industry in India of the manufacture of costly cigarettes mainly and partly from the imported leaf. This industry when allowed to grow under the shadow of progressively increasing tariffs on imported cigarettes is likely to further stimulate the production of similar leaf in India and the exploration of tracts and methods suited to the same, as such stimulus has already indicated in itself in the wider cultivation of cigarette types. The state of affairs as they stand at present are in no way favourable to the cigarette industry of India.

Taxation. Tobacco taxation is being considered in India. At the present there is no excise tax on the production of Cigarettes and other tobacco products in India. The Government of India considers it most difficult, if not impossible, to administer an excise tax law, so long as production of tobacco products is in the hands of a large number of small producers.

However, the Government of India recently invited the provincial governments to increase their revenue through a license tax on retailers of tobacco products and the Government of Bombay Presidency has announced its intention of extending to the entire Presidency the dealer-license-system, which already exists in the Bombay city. A license will have to be purchased by all dealers in tobacco products except the grower. It is likely that all the provinces will follow the lead taken by the Bombay Presidency. At present the tobacco licensing bill is published and being discussed in the Madras legislative council. The bill provides that no person shall sell or expose for sale any tobacco except under a license granted by the Collector. But exception is made in the case of growers and manufacturers who will be free to sell tobacco grown or manufactured by them to other growers or manufacturers or licensed vendors. Manufactured tobacco is divided into 2 classes (1) Class A comprising cigars, cheroots, cigarettes, cigarette—tobacco and (2) class B, comprising all other kinds of manufactured tobacco.

The bill also provides for the grant of licenses for the exclusive privilege of selling by retail in defined areas all forms of tobacco

except manufactured tobacco of class A. The monopoly holder may lease or assign the privilege, but neither he nor his lessee or assignees can excercise the right of retail vend unless and until he has received a license in that capacity from the Collector. Licenses on payment of fixed fees will be granted for the retail sale of manufactured tobacco of class A. Sir Charles A. Souter, the revenue member, in this connection said "Our first idea was that we should raise this tax by a system of monopoly. This system is not a new one in this presidency by any means. We in fact started the whole of abkari system by monopoly vending which gradually gave way to our present system. A monopoly has not got the objection of something new and not understood by the presidency. It may be that the monopoly vending of tobacco might cause a considerable dislocation of the trade and what is more important from our point of view probably cause very considerable opposition. But we do not want to cut out the possibilities of monopoly vending altogether. Therefore we came to the conclusion that we should have an alternative system which is now embodied in the present bill, that in the system of fixed fees for the right to sell tobacco with the proviso that if, in the future Government should think it advisable to introduce monopoly vending they should have power to do so. And the intention of the Government is, if this House should pass this bill, to introduce only a fixed fee system of licensing the sale of tobacco".

This works as a disability for the several tobacco trading firms who act as intermediaries between the growers and manufacturers. Next to the Imperial Tobacco Company's interests it is these wholesale exporters who are not growers themselves but have been responsible for stabilising the tobacco trade and for really giving the tobacco grower the required incentive. Such license on the free trading will bring about artificial inflation and deflation of prices as it suits the purpose of varied interests, which in its turn will recoil on the grower and manufacturer.

All small manufacturers and those who have recently entered the trade and as such have not been purchasing their requirements directly from the grower are hard-hit by this bill, as they, with their scanty finances and experiences can least stand the brunt of competition against well established manufacturing firms. A more closer impact than before is brought about by this bill between the smaller and larger firms in the purchase of their requirements and the chances are that the former are outwitted ultimately, and if they prefer to make their purchases through some purchasing firms naturally their initial cost of raw material will be higher than that of the larger firms who buy directly from the grower. The subtlety of implication will unravel itself in clearer perspective when the system of monopoly is introduced after the licence system is worked through for some years.

IV. Balance of Trade in Tobacco. The balance of trade has been progressing very unfavourably, but the imports have by no means decreased even after an advent of progressive industrialisation in this direction.

Table 9. *Balance of trade in lakhs of Rupees.*

Period.	Exports.	Imports.	Difference of exports over imports.
Pre-preference	56·5	132·3	- 75·8
Share of Madras	9·4	9·1	+ 0·3
1/6 rebate	98·7	205·6	- 106·9
Share of Madras	33·9	33·2	+ 0·7
1/4 rebate	110·0	248·6	- 138·6
Share of Madras	56·0	37·7	+ 18·3

The balance of trade for Madras is not bound to be what is indicated in the table as a large amount of rail-borne trade in cigarettes takes place between Calcutta and Madras.

V Conclusion. In the production of tobacco among the several countries in the world, India ranks second, and Madras, among the several provinces of India stands first. But the Indian exports occupy only an eigth place, which is not at all commensurate with her rank in production. Countries like Nyasaland, Southern Rhodesia of far recent agricultural development and those like Dutch East Indies and Greece, which do not possess as much variety of climatic and agricultural conditions have been able to occupy a very important position in the world trade in this commodity.

The opinions elicited by the Indian Trade Commissioner from the several tobacco firms in the United Kingdom have been very favourable to the Indian cultivator, if only he could supply continuously leaf of uniform quality and at cheaper prices than at present. A difference of 7d per pound more in the case of Indian flue cured leaf (ls-3d) than that (8d) of non Empire tobacco of similar quality prevents larger purchase of Indian leaf in the United Kingdom market. This difference is not because of the higher costs of production in India than in other competing Empire countries (Nyasaland, Southern Rhodesia, Canada etc.) or non-Empire countries (United States of America etc.). In fact the prices (5 to 6 annas per pound) received by the Indian cultivator for the flue cured tobacco are just about equal to, if not on average, lower than those (12 to 14 cts) or $5\frac{1}{4}$ to $6\frac{1}{4}$ annas per pound received by the United States of America farmer in United States of America for the same quality. Similarly the Rhodesian farmer is also receiving 7·6 d per pound of flue cured leaf. It is therefore clear that the price paid to the Indian tobacco farmer is the same as that received by the tobacco farmer in other Empire and non-Empire countries. The same preferential duty as that of India operates on the imports from the several Empire countries into United Kingdom. But the Indian leaf is found to be priced 7d higher than that of other Non-Empire countries

w[illegible]ar even higher duties, and even far less agriculturally developed [illegible]untries like Nyasaland etc. are able to compete successfully w[illegible]ia. Obviously therefore the exporting agencies should be be[illegible]is kind of show. Under the above circumstances the present tax will further enhance the middleman's charges much to the detriment of the tobacco grower. Though it appears more advantageous to reduce the percentage of moisture to less than 10 per cent in which case the advantage in the preference duty will be 3⅛d per pound of unstripped leaf and 2⅝d per pound of stripped leaf, the disparity in the prices cannot intelligibly be explained except by the presumption arrived at above.

Table 10. *Table showing the rates of full and preferential duty.*

Customs duties.	Rates of duty per pound			
	Full	Preferential.	Preference difference.	
Tobacco Unmanufactured.				
Unstripped.	£. s. d.	£. s. d.	s. d.	s. d.
Containing 10% or more moisture.	0—9—6	0—7—5½	2—0½	0—3⅛
„ less than 10%	0-10—6	0—8A2⅞	2—3⅝	
Stripped.				
Containing 10% or more moisture.	0—9—6½	0—7—5⅞	2—0⅝	0—2⅝
„ less than 10% „	0-10—6½	0—8—3¼	2—3¼	

Now in view of the exporting agencies jeopardising the interests of the Indian tobacco grower in the United Kingdom market it is hoped the Government will be able to investigate into the causes and rescue the grower from this predicament.

If by the tobacco licensing bill the intention of the Government was only to raise more revenue, the increasing imports of cigarettes should have been taxed further. When the tobacco was treated as a luxury, the consumer should be taxed. Among the consumers the consumer of the costly goods should be taxed more than the consumer of the cheaper goods as with the former only it is a luxury. Increased tax on imported cigarettes and imported leaf, the latter being at a slower pace, while swelling the revenues, would have contributed to greater protection for local manufacture, and stimulation of growing suitable types for the same. It is more desirable that the tax should be administered at the factory itself as in the case of matches, than at intermediate places as the wholesale and retail dealers and this was characterised by the Government itself as "Vexatious".

Most of the Indian tobacco exported is best suited to pipe tobaccos. Generally there is keen competition in the pipe tobacco market, but a fair amount of room exists in the cigarette tobacco market for suitable types. The internal Indian market is also of great importance as the cost of imports in cigarettes is as great as Rs. 1 9 crores. The growing demands for cigarette tobacco both in India and in foreign markets indicate the rich future that lies in the lap of lighter

types of tobacco. Samples of American types grown in India were generally liked in the United Kingdom market. The Indian Sun-cured cigarette types of tobacco could not be relied upon due to larger quantities of moisture than required. The flue-cured types had met with a fair amount of appreciation, but the price quoted was too high to attract attention. Therefore in view of the change in the outlook of the commerce in tobacco, survey and fixation of definite zones for cigarette and pipe tobaccos have to be made towards a progressive stabilisation and improvement in the trade.

With the establishment of more responsible agencies for marketing and espousing the cause of Indian tobacco in the foreign markets, the balance of trade would ultimately become favourable to India commensurate to her unique position as a tobacco producer of the world.

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CHEMICAL PROBLEMS IN CROP PRODUCTION

BY SIR EDWARD JOHN RUSSEL, O.B.E., D.Sc., F.R.S.

The classic chemical problems in crop production centre round the feeding of plants. It was in 1840 that Liebig by chemical reasoning and Lawes by empirical trials applied in practice the knowledge gained by plant physiologists about the nutrition of plants. Up to that time many agriculturists, knowing nothing about the scientific evidence to the contrary, had assumed that plants feed on the organic matter in soil. Liebig in his vigorous writings showed them that this was not so; he pieced together the scientific knowledge and gave a convincing picture of the plant deriving most of its food from the air in the form of carbon dioxide and oxygen, and the remainder from the soil, water and simple compounds of nitrogen, phosphorus, sulphur, potassium, calcium, magnesium, iron and other elements. These are then built up into the complex carbohydrates, proteins and other substances which finally form the plant tissues. Liebig argued that the soil resources could be increased by the addition of the appropriate chemical compounds, and Lawes showed how to do it; he set up experimental fields at Rothamsted and a factory in London, thus starting the artificial fertiliser industry which has now grown to such enormous dimensions that some 35 to 40 million tons are made annually in the different countries of the world. There are many technical problems connected with the industry that could profitably be discussed, but I shall confine myself to those relating to

the agricultural side. For many years these were mainly concerned with showing how to fit the fertilisers into everyday farm use. The results were very striking.

Crop increases of 30 or 50% were not uncommon; the cereal crops were greatly increased by nitrogenous manures, and the very important root crops by superphosphate; the Rothamsted field plots started in 1843 afforded such striking demonstrations as farmers had never before seen. In the words of Gilbert, the distinguished collaborator of Lawes, the unmanured crops growing alongside of their neighbours might almost be fancied to say: "If you won't feed me I won't grow." Those were spacious days for the farmer; prices were high and costs low; there was no need for stinginess in applying fertilisers. They were put on the ground in adequate amounts and a good response fully repaid the cost.

As years went by, costs began to rise and prices to fall; the margin of profit became exceedingly narrow and finally disappeared. New and more economical method were required and the chemist was called in to find how little of the various fertilisers needed to be added to soils to serve for a particular crop. The first hypothesis had been that plants took from the soil those things they needed, and if, therefore, one wished to discover the fertiliser requirements of plants it was only necessary to find out what quantities of fertiliser constituents the plant contained. Average crops were therefore analysed so as to discover the amounts of phosphorus, potassium, nitrogen, etc., present; the soils were also analysed to find the amounts per acre of these elements present in suitable form for plant nutrition, and a simple subtraction sum showed how much, if any, artificial fertiliser need be supplied. The method was much used some 30 or 40 years ago; it was highly developed in the United States by Cyril Hopkins, who spoke of drawing up the "invoice of the Soil":

Phosphate in crop	...	...	...	...	30 lb. per acre.
,, ,, soil	...	...	...	...	600 ,, ,, ,,
Average of good soils in district			...	...	2000 ,, ,, ,,

There seems sufficient phosphate for a number of crops, but, as the amount is far below the average content, there will certainly be need for phosphatic fertiliser *if the average soils are known to respond*—which in the region in question they were. This procedure was simple; it had, however, the weakness that it was not adequate—for two reasons: (1) one cannot say exactly how much available plant food there is in the soil; and (2) the plant is not a fixed definite entity, it has considerable range of variation.

It might seem relatively easy to determine how much phosphate or potash a given soil contains, but actually the total values given by ultimate analysis have had only limited utility. Hopkins was able to get something out of them, as also was Prescot in Australia, but in normal English experience they are not helpful. Better results have been obtained by adopting some analytical method that distinguishes between the more and the less soluble constituents—a distinction first emphasised by Daubeny in 1845 and reduced to laboratory terms by Dyer in 1894: indeed Dyer's method still remains the most useful we have.

The amounts of nutrient and other materials in the plant, however, are not determined by the needs of the plant but by the quantities available. The plant roots act like a partially permeable membrane; they absorb some of everything that is soluble in the soil; not, however, in the proportion in which it exists in the soil, but in a proportion modified by certain characters of the plant. This is well illustrated by the following figures showing the mineral constituents of grasses and clovers growing intermingled on the Rothamsted grass plots:

Variation in Composition of Mineral matter in plants growing side by side (Rothamsted Park Grass).

	Per cent in pure ash.	
	Grass.	Legumes.
CaO	7·6—11·8	21·4—30·3
MgO	2·4— 3·7	3·6— 7·5
K_2O	22·6—37·9	11·2—31·3
Na_2O	0·4— 5·3	0·6— 9·6
P_2O_5	5·7— 9·7	5·1— 8·6
SiO_2	17·3—36·6	1·3— 1·9

Some of these absorbed substances greatly stimulate the production of carbohydrates and proteins in the plant: others do not. The final composition of the plant is, therefore, profoundly affected by the compositions of the soil, and, except in cases of extreme deficiencies, is not a good index of the fertiliser requirements of the plant.

A different approach has, therefore, become necessary. It is recognised that the subject is much more complex than had been supposed and it has had to be put on a much broader basis. The purpose of modern work is to discover the factors that govern the growth and composition of plants, and, having done that, to find the simplest and most economical method of bringing them under control. The study of soil fertility thus resolves itself into two parallel sets of investigations. Plant physiological work shows what the plant needs in order to attain its maximum growth; more precisely, how growth is affected by variations in the conditions, especially in the supplies of nutrients, water and air for the root, reaction of the medium, etc. Studies by soil investigators show how far a particular soil is likely to satisfy the conditions for full plant growth, and how it can be made to do so better than it naturally would. Soil fertility is dependent on five main factors: namely, adequate plant food supplies: adequate water supply; adequate space for the root system; air supply to the roots; and absence of injurious substances. In practice, these are closely linked. A food supply adequate for one level of water supply is quite inadequate for another. F. G. Gregory and F. Crowther made some good experiments in the Sudan showing that, as the amount of irrigation water increased, the response to added nitrogen fertiliser also increased. It is, therefore, impossible to speak of the adequacy of the soil supplies of plant food except in terms of water supply. The same holds true of the other conditions of growth, particularly of air supply, which is largely a matter of soil texture.

The relation between the quantity of nitrate in the soil and the quantity of nitrogen present in the plant is fairly simple. The total quantity of nitrogen in the crop is roughly proportional to the supply, but the way in which the nitrogen is used varies according to the amount present and the water supply. The added nitrogen can lead to corresponding increase in crop without particular change in nitrogen content, or, if for any reason it fails to increase the yield, it can cause an increase in nitrogen content that may become very marked.

Extreme cases being omitted, the variations in composition due to increases in nitrogen supply are much less than the increases in yield. The first increments of nitrogen give considerable increments of crop; later ones give less. So the percenitage of nitrogen in the crop, and especially in the grain, is first unchanged or even falls as the nitrogen supply increases, but with later

increments of nitrogen it rises steeply. Over a fairly wide range, the nitrogen content is more affected by the water supply than by the nitrogen supply. This is what happens in normal fertility conditions ; it holds not only for nitrogen but for the other elements that increase plant growth. The fertiliser causes the plant to grow more but does not much affect its composition or its quality.

Thus, sulphate of ammonia, in conjunction with superphosphate and potassic fertilisers, usually increases the potato crop by some 15 to 20 cwts. per acre for each cwt. that is given up to 2, 3, or sometimes 4 cwts. per acre. The change in composition is only slight, as also is the change in marks assigned by an expert chef for quality. On the other hand, the effect of soil differences is very great, as shown by a comparison of the Rothamsted with the Woburn results:—

Marks for quality of Steamed Potatoes (1929).

Cwt. K_2O per acre	Woburn (Light soil)	Rothamsted (Heavy soil)	Cwt. N per acre.	Woburn (Light soil)	Rothamsted (Heavy soil)
0	32·6	28·5	0	34·4	29·2
0·5	33 6	29 5	0 3	33·3	29·3
1 0	34·5	29 6	0·6	32·9	29·1

Percentage of Dry Matter in Tubers grown with Different Potassic Fertilisers.

K_2O per acre.		No of potassic fertilisers.	Sulphate of potash	Muriate of potash.	30% potash rate of dressing salt.
1·0	Woburn, 1929	27·5	26·7	26·2	24·8
1·0	Rothamsted, 1929	26·1	25·9	24 9	24·2
0·8	„ 1930	23·1	23 3	22 7	22·1
0·8	„ 1931	20·9	20·5	20·2	20 2
0·8	„ 1932	22 6	22·1	...	...

Remarkable results are obtained when one gets away from the normal fertility range to the extremes of deficiency or excess. The form of the plant changes, in extreme cases, considerably ; this is well shown in the Rothamsted experiments with mangolds. A large excess of nitrogen and a prolonged deficiency of potassium bring about striking changes in the plant and affect its reaction to insect and fungus attack. Wallace at Long Ashton has shown that nitrogen starvation of apple trees heightens the colour of the fruit.

Although it is not possible to lay down precise fertiliser recipes, crops do show certain general requirements. Practically all crops respond to nitrogenous fertilisers. Root and potato crops frequently respond also to superphosphate, and grass land to basic slag; leguminous crops, mangolds, potatoes and fruit commonly, to potassic fertilisers also, Wallace has shown that potassic and nitrogenous fertilisers are, as a rule, the most important fertiliser elements for fruit, phosphate being advantages only for cover crops and for straw berries. In the west country at least, the potassium supply is the key to the successful nutrition of fruit trees, and by extending the use of potassic fertilisers, it has been possible to extend fruit growing and improving greatly the yields and quality in existing plantations. Trees suffering from shortage of potassium show a curiously high phosphorus content.

Differences in composition of the crop may have far-reaching consequences. Varieties of wheat have been bred at Svalof for resistance to winter frost; successful ones are found (Bengt Lidfores; Akerman) to contain a higher percentage of sugar in the leaf than the others. It is not supposed that the sugar confers frost resistance ; the evidence is rather that the freezing of water in the intra-cellular spaces of the leaf causes water to pass out from the cell. making the cell sap more and more concentrated till finally the protein is irreversibly precipitated, apparently by a salting-out process, and the cell then dies. Maximov has shown, however, that the presence of sugar in the sap protects the protein against precipitation.

There are also some unexpected results. The same sugar that is associated with frost resistance also makes the leaves attractive to hares, so that winter resistant varieties tend to be eaten more than others.

The composition of the crop naturally affects its value as food, especially as animal food; this is particularly so for grass, which forms a large part, sometimes indeed the whole, of the food of the animals. In its early stage, grass is richer in protein and in mineral matter than at any later period; it therefore, has high feeding value and efforts are now being made to preserve dried young grass for winter feeding. Among its other valuable constituents is carotene, the precursor of vitamin A, and the cause of the rich yellow colour is cream. Experiments at Jeallot's Hill have shown that yellow cream can be obtained in winter if the animal is given some of this dried grass.

In southern hemisphere, notably Australia and South Africa, and occasionally in England and Scotland, pronounced deficiencies of calcium, phosphorus, or other elements sometimes occur in soil, causing equally pronounced deficiencies in composition of vegetation and these lead to marked nutritional troubles with the animals. These were first studied by Arnold Theiler and his colleagues in South Africa and the subject is being developed at the Rowett Institute, Aberdeen. Typical analyses of herbage associated with healthy and with diseased conditions of the animals are as follows :—

Percentage of Mineral Constituents in Dry Matter of Herbage.

	Scottish hill pastures		Kenya		New South Wales	
	Healthy	Diseased	Healthy	Diseased	Healthy	Diseased
CaO ...	0·65	0·21	1·00	0·49	0·465	0·168
P_2O_5 ...	0·67	0·29	0·93	0·19	0·184	0·047
K_2O ...	2·66	1·51	2·25	0·83	0·143	0·087
Na_2O ...	0·37	0·12	0·07	0·02	...	...
Cl ...	0·64	0·52	0·42	0·18	...	..
N ...	2·50	2·05	...	...	...	...
Total ash ...	7·18	5·33	...	...	...	...
Silica-free ash ...	5·85	2·82	...	...	...	...

The remedy consists in supplying the missing elements as "licks" or in fertilisers,

Where the diet includes a number of foods (as the ordinary human diet), differences in composition of individual foods tend to even out, so that for practical purposes the composition of individual items has usually little dietetic significance.

The factor of competition comes into play and introduces complications when several plants are growing together, such as the mixture of leguminous

and non-leguminous plants grown for silage or fodder purposes or occurring naturally in grass land. Leguminous plants derive their nitrogen from the bacteria living in the nodules on their root ; these fix nitrogen from the air and make the plants independent of nitrogenous fertiliser. The non-leguminous plants, however, are much favoured by nitrogenous fertiliser and grow so vigorously that they tend to crowd out the leguminous vegetation. Thus, it may happen that additions of nitrogenous fertiliser cause no increase in the amount of protein produced per acre. Phosphates, on the other hand, favour the leguminous plants, so that these increase when phosphatic fertiliser is supplied. This accounts for the remarkable improvements effected by basic slag on pasture land.

In regard to these principal elements of plant nutrition, it is now recognised that more and better field experiments are needed to provide the main facts on which the agricultural chemist can then proceed to work. The methods of field experiments have recently been completely overhauled; the experiments:, of course, can never be exact, but they are now done in such a way that each experiment gives a measure of its own error. Simultaneously, chemical examination of the soils is made.

In recent years, it has been found that certain elements other than the classical ones are needed in very small amounts. Larger quantities become harmful, but the proper small quantity is indispensable.

Boron has been much studied at Rothamsted. Miss Warington found that it is essential for the proper devolopment of broad beans, and later workers have shown that other plants need it also. Sugar beet affords an interesting example ; in absence of the necessary trace of boron, a certain disease appears, which has caused some trouble in Central Europe and in the Irish Free State.

Manganese has been studied by Samuel and Piper at the Maite Institute, Adelaide. A trace of manganese sulphate (1 part per million) was found to be essential to the growth of plants, In its absence oats become liable to the grey fleck disease.

Allison in Florida has shown that minute traces of copper are essential to plant growth : he has obtained dramatic increases of yield on the Everglade soils by additions of traces of copper sulphate We have, however, not yet found soils in this country that respond to copper salts. Zinc appears to be essential, at any rate for fruit trees ; in its absence the curious rosettee diseases set in.

Lithium salts are stated by Sir Rowland Biffen to confer resistance to mildew and yellow rust on wheat grown in pots.

Molybdenum salts injected into plants have been found by Miss Sheffield to induce a trailing habit of growth and also to produce symptoms apparently identical with those of virus disease in *Solanum nudiflorum*. W. A. Roach shows that the roots of fruit trees vary in their power of assimilating molybdenum from the soil : some can do it and others cannot.

Some of these curious stimulating substances are organic. They were first called auximones or growth promoters ; now they are called auxins or growth enzymes. Owing to the difficulty of working with them, it has not always been possible to distinguish their effects from those of the inorganic promoters, and some of the auximone effects of the older workers are probably attributable to iron. But there are cases where the active agent is an organic substance, though, owing to difficulties of working, it is not possible to be quite sure. F. W. Went and Kozl have recently isolated, from the growing point of plants, an auxin which increases the growth of the upper parts by stimulating the elongation of the cell, and restricts the growth of the roots ; they have gone so far as to ascribe the formula $C_{18}H_{32}O_5$ to one form of the auxin, and $C_{18}H_{30}O_4$ to another.

A remarkable substance has recently been isolated by H. G. Thornton at Rothamsted. The invasion of the root hairs of leguminous plants by the nitrogen-fixing bacteria is preceded by an excretion from the roots, which causes the bacteria in the soil to multiply. In turn, the bacteria excrete something which causes the root hairs to multiply and to curl; on the inner bend of curl, the bacteria enter. This substance has been isolated and is being studied.

The late S. U. Pickering obtained evidence of plant excretions capable of injuring other plants: these results have never yet been satisfactorily explained. There is much empirical knowledge about the harmful effect of growing plants on soil: fruit stocks, for instance, cannot be raised in succession on the same land, but new land is needed for each crop. Whether this is the result of excretions or of exhaustion of some essential minor element is not known.

The growing plants also affect the soil in other ways. Wallace has shown that grass grown as a cover crop raises the potassium and the iron content of the soil water and may thus cure iron and potassium deficiencies on certain soils; it also lowers the N/K ratio. He thus explains the paradoxical result that clean culture of fruit is not always the best: weeds in the orchard have their uses.

The production of cellulose in the plant is now being studied at Rothamsted, by A. G. Norman, and is opening up considerable possibilities in view of its importance in industry.

The ripened seed has its own group of problems. Barley has been studied most completely and L. J. Bishop has found surprising regularities in the make-up of the grain under various conditions of growth. The nitrogen content may vary from 1·2 to 2·4 per cent. and the proteins and carbohydrates change correspondingly, but always in accordance with a definite pattern which remains constant for any given variety. The value of barley for brewing depends to a considerable extent on the quantity of nitrogen compounds present, large amounts being detrimental, especially for beers that have to be kept for some time before consumption. The value of wheat for baking, on the other hand, is usually enhanced by high protein content, but it is also much affected by the physical state of the protein.

Many of the chemical problems in agriculture are shifting over to the direction of physical chemistry and especially to the branch that deals with colloids.

—*Journal of the Chemical Society*, Jan. 1935.

Correspondence.

To The Editor, Madras Agricultural Journal, Lawley Road P. O.

Sir,

With reference to a short note under the caption " A note on the occurrence of *Pempheres affinis of Hibiscus esculentus* in Malabar " published in the May issue of your Journal, I would like to point out that the phenomenon of the occurrence of Pempheres, sought to be conveyed as a new discovery, has already been known at least since December 1935. It is not my intention to enter into a controversy in regard to any claim for priority in the matter of this observation. My purpose is simply to draw the attention of your readers to the following facts which may serve to elucidate the question at issue.

In pursuance of the general programme of a preliminary survey of Pempheres and parasites a tour in certain parts of Malabar was undertaken in December 1935 and in the course of this investigation this problem has been studied and reported upon as may be evident from the following extracts from my monthly

report for December 1935. " The most striking item of new knowledge that has emerged from this preliminary survey is the discovery of heavy Pempheres infestation in Bendai (*Hibiscus esculentus*) plants in a variety of ecologically different tracts including great elevations like Manantoddy. Until this visit no such profuse breeding has been noted. In fact the question of Pempheres breeding on Bendai was considered uncertain. The absence of the weevil in cottons wild and cultivated and allied plants even when growing adjacent to infested Bendai plants and the occurrence of the same in scores breeding profusely on Bendai plants tend to throw some light on its original habitat which still remains largely a matter of conjecture. It has also enlarged its known range of distribution. This observation also lends strong support to the supposition that Bendai is probably one of the more natural hosts of the weevil."

It is also stated by the writer of the note that he observed the presence of Pempheres adults on Bendai plants on the farm as early as the year 1933. It may be significant in this connection to point out that, in a joint paper on Pempheres problem by the author of the note and others published in June 1934, Madras Agricultural Journal, Vol. XXII, No. 6, p. 208, no mention of this observation seems to have been made. On the other hand the following statement recorded in that paper argues against the proposition "The only feature that makes a measure of control such as this somewhat hopeful is, that the insect so far as our experiments go, is unable to breed, leaving a few Corchorus plants, on any plant other than cotton" (p. 208).

The following extract from a letter written by the Farm Manager, Taliparamba under date 2—12—1935 in reply to my enquiry about the occurrence of Pempheres on cotton, Bendai or other allied plants in the farm and its neighbourhood speaks for itself. After stating that cotton, Bendai or other alternate hosts are not available on the farm he writes as follows :—"I have even enquired of the Entomology assistant about the occurrence of this pest on any of the local plants and he says that he has not come across this pest or the parasites on them."

I have presented these extracts for the information of your readers and I refrain from making any comments.

A. C. & R. I., 11—6—'36.

P. N. Krishna Ayyar,
Parasitologist.

II

To The Editor, Madras Agricultural Journal, Lawley Road P. O.

Dear Sir,

In the May issue of your Journal under Research Notes I was glad to read Mr. Gopal Menon's note on the occurrence of *Pempheres affinis*, F in Malabar. I may, however, give for the information of Mr. Menon and others who are interested in this subject, that this is not the first record of this weevil in Malabar. For, I noted the same on *Hibiscus esculentus* in N. Malabar (over fifteen years ago and have recorded the fact on p. 321 of the Report of the Preceedings of the 3rd Entomological Meeting Pusa 1919. Mr. Menon has evidently overlooked this previous record.

T. V. Ramakrishna Ayyar.
Girja Farm
Mundur (S. Malabar.)

AGRICULTURAL JOTTINGS.

BY THE DEPARTMENT OF AGRICULTURE, MADRAS.

Transplanting Paddy in Anantapur. In Anantapur taluk noted for its very low rainfall and absence of any large irrigation systems, approximately 20,000 acres are under paddy. As can be expected the supply of water in tanks is precarious and irregular. The local practice of raising the crop is by broadcasting when tanks receive their full supply. No advantage is taken of small supplies of water reserved in July and August, but cultivation is delayed till December leading to wastage of water. In order to remedy this defect the Department of Agriculture has been doing propaganda and demonstration in raising dry nurseries of paddy in July and August with the available supply of water and starting cultural operations taking advantage of early rains and in transplanting seedlings in August and September. In spite of strong opposition from a section of Ayacutdars to open the sluices in August, demonstrations were conducted under Anantapur and Singanamala tanks during the three years 1932—35. It was demonstrated that the increased yield by transplanting varied from 9—12 % and the extra produce was valued at about Rs. 5 per acre. It is interesting to note that the methods recommended are gaining ground also under spring channels and wells. In one particular village (Illur) it is reported that broadcasting has been completely replaced by transplanting. At present about 10 % of the total area is under this new method.

Paddy work in Pattambi (Malabar). As a result of an intensive study and careful testing of a very large number of pure line selections isolated from the major varieties grown on the West Coast, ten high yielding strains have been released from the agricultural station at Pattambi. Most of these are red riced varieties. A majority of them are intended for the first crop. These strains with the exception of one have given 10—22 % more yield than the ryots' bulk. One strain has also been produced for South Kanara which gives 18 % increase in yield over the bulk and which has also been found to stand inadequate water supply.

Rotations and Manuring Sugarcane in Palur (South Arcot). Ryots in South Arcot are known to apply very large doses of manure to sugarcane as compared with ryots in other parts of the Presidency. The reason is that in view of the profits accrued from sugarcane ryots have been accustomed to follow a close rotation so that sugarcane is grown almost every other year in the same land. A long standing crop like it exhausts the soil and if the field is cultivated every other year with it needs heavy dressings of manure. A rotation experiment conducted for 10 years in the Palur agricultural station showed that growing sugarcane every other year is detrimental to the soil, that it is economical to grow it once in three years and that good yields of cane could be obtained if grown on the same land once in four years.

In the case of manures, a trial started in 1928 and concluded recently indicated that Fiji B, the standard variety of South Arcot responds to heavy manuring up to 200 lb. of Nitrogen per acre applied in the form of an oil-cake (groundnut) and Ammonium Sulphate mixed in the proportion of 3 : 1. Applying manures in 3 doses is preferable to applying them once or twice. To obtain the maximum returns it is advisable to add Potassic and phosphatic manures to the nitrogenous manures. It is also noticed that sodium nitrate by itself is inferior to a mixture of groundnut cake and ammonium sulphate.

Green Manure crops and Insects. Sunnhemp, Dhaincha and other green manure crops which are grown in the summer months are often subject to insect attacks. Caterpillars are the worst offenders. At the Aduturai research station, it was

found recently that on Dhaincha a bug acted as an efficient predator on all caterpillars including the hairy variety. The Entomological Assistant is devoting his special attention to this bug and is trying to introduce it in places where it is not present in numbers to see if they would check caterpillar pests there.

College News & Notes.

Mr. R. C. Broadfoot, Principal left for England on leave and Mr. R. W. Littlewood officiating Principal has taken over charge,

Jubilee celebrations. The Managing Committee is busy making preparations, for the Jubilee celebrations, and it is hoped that with the co-operation of all the officers of the department, the function will be a grand success.

Students. The college reopened after the vacation, and the Second and Third year Classes have settled themselves for work. The first year class will join in the first week of July.

Selection Committee. The committee for selection of students for the college, consisting of the Director of Agriculture, the Principal, Rao Sahib J. Ponnai Gounder and Mr. N. Sivaraj were at Coimbatore, on the 24th and 25th instant.

An omission. The names of Messrs. P. Jeevana Rao and C. Krishna Nair were inadvertently omitted in the list of resident members, despatched last month to the members. These names may be kindly included in the list.

* * * * * * * *

Nomination Papers. Members of the Union are reminded that the last day for sending Nominations for election of office bearers in 1936 is the 15th of July.

Weather Review (MAY 1936).

General. Scattered thunderstorms caused widespread rain in the Peninsula, North Madras Coast, Malabar and in South-east Madras during the first half of the month when typical hot weather conditions prevailed associated with the normal pressure distribution and high day temperatures in the interior of the Peninsula.

A temporary advance of the monsoon occurred off the Ceylon and South Malabar coast about the beginning of the third week of the month and locally heavy rainfall occurred there on the 20th and 21st.

Conditions became unsettled in the South-east of the Bay and a depression formed in the centre of the Bay on the 23rd. This caused an extension of the monsoon into Lower Burma and the Andamans. The depression moved towards Bengal and crossing the South Bengal coast as a cyclonic storm of severe intensity on the 27th night, filled up over East Bengal by the 29th after causing widespread and locally heavy rain on the Orissa Ganjam coasts, and in Bengal and Lower Burma during its traverse.

The Arabian sea branch of the monsoon remained fairly active on the Malabar coast, though showing signs of weakening about the 30th.

Rainfall was on large excess in the South Malabar coast and in the Circars and locally in the Tinnevelly district. Elsewhere it was practically normal.

Day temperatures were generally in excess in the interior of the Peninsula during the first three weeks. Rentachintala recording 112° on one occasion.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	9·5	+7·5	14·3
	Berhampore *	4·1	+2·3	9·6
	Calingapatam	3·3	+0·7	6·5
	Vizagapatam	3·9	+1·9	9·0
	Anakapalli *	7·9	+5·9	- -
	Samalkota*	2·2	+0·8	11·9
	Maruteru *	2·7	+1·4	7·0
	Cocanada	3·4	+1·4	10·0
	Masulipatam	6·9	+5·6	11·7
	Guntur*	5·5	+3·4	14·9
Ceded Dists.	Kurnool	1·1	0	3·6
	Nandyal *	0·8	-0·7	2·5
	Hagari *	2·8	+0·8	4·4
	Bellary	1·7	-0·3	2·1
	Anantapur	3·0	+0·9	3·9
	Rentachintala	3·9	—	3·9
	Cuddapah	1·1	-0·5	2·2
	Anantharajupet *	1·9	—	—
Carnatic	Nellore	0·4	-0·4	2·6
	Madras	0	-1·1	4·0
	Palur *	1·5	-0·4	5·9
	Tindivanam *	1·8	+0·3	6·3
	Cuddalore	1·5	+0·9	5·9
Central	Vellore	2·4	+0·1	4·1
	Salem	7·5	+2·8	12·4
	Coimbatore	2·1	-0·3	6·0
	Coimbatore Res. Inst. *	2·0	-1·2	5·8
	Trichinopoly	1·3	-1·7	7·2

Division	Station	Actual for month	Departure from normal @	Total since January 1st
South	Negapatam	0·1	-1·5	8·9
	Aduthurai *	0·3	-1·9	6·1
	Madura	0·6	-2·3	8·4
	Pamban	0·5	-0·3	8·5
	Koilpatti *	2·4	+0·4	8·6
	Palamkottah	5·6	+4·0	11·3
West Coast	Trivandrum	19·7	+11·2	23·2
	Cochin	31·0	+19·3	35·7
	Calicut	18·0	+9·5	29·5
	Pattambi *	12·1	+3·2	18·5
	Taliparamba *	9·8	+1·1	11·7
	Kasargode *	13·3	+5·9	15·7
	Nileshwar*	9·6	-0·6	11·9
	Mangalore	8·5	+2·3	12·5
Mysore and Coorg	Chitaldrug	1·9	-2·2	2·7
	Bangalore	6·5	+0·6	7·6
	Mysore	9·4	+1·8	12·5
	Mercara	9·6	+3·9	13·8
Hills.	Kodaikanal	7·0	+1·0	14·3
	Coonoor*	2·9	—	26·2
	Ootacamund *	8·4	+1·7	13·8
	Nanjanad *	8·4	+2·1	14·5

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Weather Report for the Research Institute Observatory.

Report No. 5/1936.

* Absolute maximum in shade.	102°F
* Absolute minimum in shade.	71·8°F
* Mean maximum in shade.	98·7°F
Departure from normal (of the month).	+ 4·4°F
* Mean Minimum in shade.	74·8°F
Departure from normal (of the month).	+ 0·9°F
Total Rainfall.	2·04″
Departure from normal.	- 1·17″
Heaviest fall in 24 hours, (record on 21—5—1936).	0·83″
Total number of rainy days.	3 days.
Mean daily wind velocity.	2·2 M. P. H.
* Mean humidity at 8 hours.	71·4 %
Departure from normal. (of the month).	- 3·3 %

* Temperatures were recorded only upto 20th of May.

General. Severe hot weather conditions prevailed during the first fornight of the month with day temperatures in large excess of normal. The absolute maximum recorded was 102° on the 6th.

The temporary advance of the monsoon on the West coast, reduced the temperature in the second half of the month.

Rainfall was 2·04″ which was 1·17″ below normal.

P. V. R. & D. V. K.

Departmental Notifications.

Appointment. S. Venkataramanappa, B. Sc. Ag. is reappointed to the M. A. Subordinate Service and is posted to Vellore.

Leave. K. Ambikacharan A. D. Hindupur l. a. p. on M. C. for 3 months from 16—4—36. T. D. Eswara Iyer, Asst. Farm Manager, Sim's Park, Coonoor, l. a. p. for two months from 1—6—36, M. Eggiaswamy Iyer, A. D Chengam l. a. p. for 3 months from 8—6—36. P. K. Natesa Iyer, A. D. Srivalliputhoor, l. a. p. for 3 months from 15—5—36. C. Jaganatha Rao, Assistant in Cotton, l. a. p. for 2 months and 15 days from 3—5—36. S. V. Kuppuswamy, Asst. in Soil Physics l. a. p for 2 months from 22—4—36. N. Kesava Iyangar, Assistant in Cotton Dry Farming Station, Hagari, leave out of India on half average pay for 27 months from 15—8—36. V. S. Narayanaswamy Iyer, A. D. Tanjore, l. a. p. for 4 months from 22—6—36.

Transfer. Guruswami Naidu, F. M. Kalahasti to Live Stock Section, Hosur. A. R. Krishnamurti Iyer, to revert to the Department from Borstlal School, Tanjore. K. Venkataswami, A. D. Vellore on probation to be F. M. Millet Station, Coimbatore. P. V. Venkateswaran, F. M. Millet Section to be Lecturer in Agriculture, vice S. Narayana Iyah on other duty. K. Sanjivi Shetty, A. D. Bellary to be F. M. Kasargod M. Bhavani Sanker Rao F. M. Kasargod, to be Assistant to O. S. S. in Neleshwar. N. Ganeshamurti, Assistant, O. S. S. to report himself to D. D. viii circle.

Gazettee Notifications. Mr. T. Murari to be Dy. Director of Live Stock. Mr. Kunhikutti to be Supt. Live Stock Station, Hosur. Mr. T. G. Anantaraman to be Offg. Asst. Marketing officer vice Mr. K. Gopalakrishna Raju, on leave. Mr. C. Ramaswami to be marketing officer. Mr. C. R. Sreenivasan, Supt. A. R. S. Pattambi, to be Marketing officer during the period of leave of Mr. C. Ramaswami

ANNOUNCEMENT

DIAMOND JUBILEE OF AGRICULTURAL EDUCATION IN INDIA & THE SILVER JUBILEE OF M. A. S. U.

WILL BE HELD ON

29th, 30th, 31st JULY & 1st AUGUST

His Excellency Sir K. V. Reddi Naidu Garu, Offg. Governor of Madras will inaugurate the Proceedings on the 29th July at 11-30 A.M. and visit the Exhibition in the afternoon.

The first Session of the Conference will be held on Thursday the 30th July. **The Hon. Mr. P. T. Rajan**, Minister for Public Works will preside.

The College Day Sports will be held on Saturday the 1st August.

The Annual General Body Meeting of the M. A. S. U. will be held on Sunday the 2nd August at 8-30 A. M.

Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXIV] JULY 1936 [No. 7.

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Editorial.

District Economic Councils. Since the formation of the Provincial Economic Council some months ago, the Government have been considering the formation of district councils and their decision on the matter, recently published, provides for the formation of these councils, in every district, as early as possible. The constitution of the council, its functions and the instructions for the guidance of Government Officers making up the council have all been detailed in the Government order, which inter alia states that the function of the council will be advisory. The main task of the council will be to co-ordinate the work of the several Departments of Government in the district, to see that the money allotted to the district for expenditure in each of these Departments is spent to the greatest advantage, and to take such steps as it may find necessary—with the willing co-operation of the people—for the improvement of village life in all its aspects.

The Government have also rightly decided that the setting up of these councils should be decided on by the people of the districts themselves, and their order outlines the procedure to be followed by the Collector of each district who will be the President of the council. It is unlikely that any of the districts would be unwilling to avail itself of the obvious advantages of a scheme which brings the different branches of Government Administration to co-operate with one another and with the people. The constitution of the council allows for non-official representation in it; probably, two non-official members will be considered not sufficient. A good deal will depend

upon the right choice of the non-official representatives who should be able to command the willing co-operation of the people in the villages. The Government we find, lay stress on the important task of the council, to create interest in and desire for improvement, among the villagers themselves. The council will find it necessary first to make a survey of the possibilities of village improvement work that could be undertaken in various parts of the district, select villages which give promise of success and later on build up new centres based on experience gained at the centres first chosen. The other day, the Viceroy of India addressing the Advisory Board of the Imperial council of Agricultural Research stated "I cannot but feel that the establishment of a greater degree of co-ordination than would appear at present to exist between district officers and the officers of the Agricultural, Veterinary and Co-operative departments, would strengthen materially the means at disposal for promoting agricultural improvement as well as rural betterment in the widest sense". We are sure that the formation of the District Economic Councils would help in bringing about this much desired co-ordination of activities.

We are glad that the programme of rural reconstruction is made to include practically every item connected with village life, even relief of indebtedness. There have been attempts made at rural reconstruction work by other agencies like the Y. M. C. A, Servants of India Society etc. in selected centres here and there, and we hope that this new Government organisation, will heartily co-operate with these other agencies and benefit by the experience already gained by them.

Imperial Council of Agricultural Research. The Imperial Council of Agricultural Research was brought into existence seven years ago as a result of the Government of India accepting one of the most important of the recommendations of the Royal Commission on Agriculture in India. The investigations of the Commission had shown the growing decline in co-ordination between the centre and the Provinces and between Province and Province due evidently to the Constitutional changes that had been introduced, and it was with a view to counteract this tendency that the Commission had recommended the establishment of the Imperial Council. It was intended to promote, guide and co-ordinate agricultural research throughout India and to link it with agricultural research in other parts of the British Empire and in foreign countries. There is no doubt that the Council during the last seven years has justified the purpose, for which it was started.

The Council has so far spent several lakhs of rupees in financing several research schemes in the different Provinces and in the Centre. The Government of India have now secured the services of two eminent British Experts to visit India this cold weather and give them the benefit of their expert advice regarding the working of the Imperial Council of Agricultural Research during the last seven years. Of

these experts Sir John Russell, F. R. S., Director of the Rothamsted Station, will deal with soils and crops and Dr. N. C. Wright of the Hannah Dairy Research Institute, Ayrshire, with dairy and animal husbandry schemes. These experts are to be helped by two Indian Secretaries, R. L. Sethi, Economic Botanist, the United Provinces and Prof. Agarwal of the Punjab Veterinary College. We hope that the experts, will, in addition to examining how far the Research Council has discharged its principal duty of co-ordinating and promoting agricultural research in India, also examine the present research programmes of the Council and advise on the most fruitful lines of research to be undertaken in the future. When a large number of investigations say, on a particular crop, are carried out in the different Provinces, it is inevitable there should be a certain amount of overlapping, but we hope that the Experts after examining the progress of research work in the different Provinces will make such recommendations as would reduce this overlapping to the minimum.

Practical Training in Agriculture. We are glad to note that to relieve unemployment among educated youth, the Government of Madras have, subject to the vote of the Legislative Council, sanctioned a scheme for training one hundred and fifty young men in practical agriculture. Applicants will be required to have at least passed the S. S. L. C. examination and they should belong to land-owning and agricultural classes. The course of training is to last for 4 months beginning from September next and is proposed to be given in one or other of the several Government Agricultural Research Stations. During the course of training they are to get a stipend of Rs. 15 a month and the only condition stipulated is, that they should go back to the land and take to agriculture as their profession. We have in recent times had educated young men volunteering to come and work as regular coolies and learn practical agriculture in the several stations but, it is doubtful whether they seriously intend to go back to the land and take to agriculture. While we welcome this new scheme, we wish it went a little further by providing a selected few of these trained men with lands and facilities to farm on their own account as has been done in the Punjab. We look forward to the success of this inexpensive experiment.

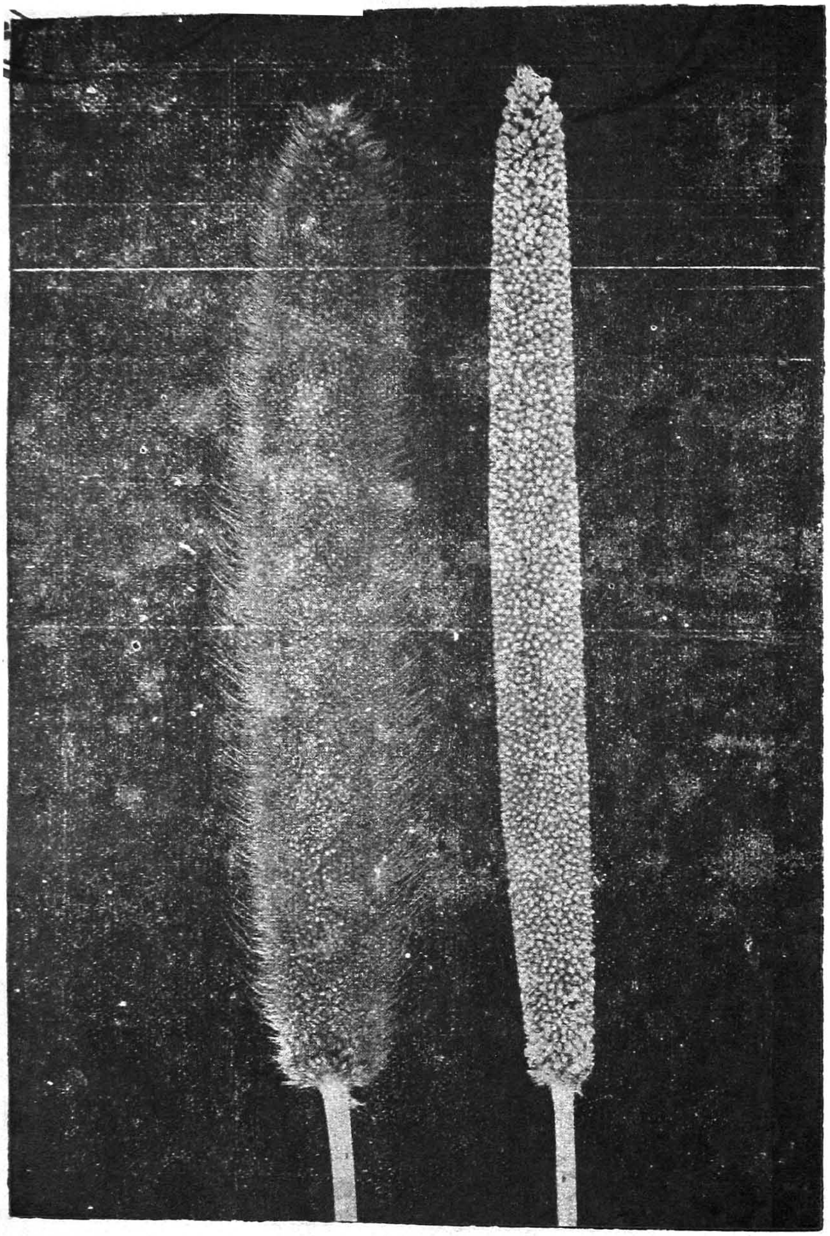
The Cecil Wood Memorial. While we are celebrating the Diamond Jubilee of the commencement of Agricultural Education in Madras and the Silver Jubilee of the Madras Agricultural Students' Union this week, we cannot but think, with pleasant memories, of Cecil Wood who had played such an important part in the activities of the College during his long stay in Madras. There can be no two opinions about Wood as the ideal Principal the College has ever had. Coming out to India in 1905 he had seen service in various capacities in the Madras Agricultural Department, but it was as Principal, which post he held for over twelve years (1909—1922), that he was best

known. Most of his students who are still in the Department, can well remember his boundless enthusiasm for activities in the College and on the field. His lectures on Agriculture were a model and we believe the notes prepared by him then still form the basis for the teaching of Agriculture in the College. Though a strict disciplinarian, he was greatly loved and esteemed by his students. Unfortunately, however, during his later days in Madras, he could not adapt himself to the changing conditions, particularly in the general desire for affiliating the College to the University which he did not quite believe would yield fruitful results. All the same we are sure that if he had continued in Madras, he would have been the first to welcome and appreciate the changes that have been introduced in the College consequent on its affiliation to the University.

Leaving Madras in 1922, he was for a short period employed by the Empire Cotton Growing Corporation in S. Africa, but he soon joined the staff of the Imperial College of Agriculture, Trinidad and took to his most favourite job, namely teaching of agriculture to the students.

It was over six years ago that some of his old students in the Madras Department of Agriculture met and decided to perpetuate the memory of his connection with the College in a suitable manner. A committee was appointed with instructions as to the form in which the memorial was to be instituted. The Secretary of the Committee had issued an appeal in the Journal inviting subscriptions for the Memorial Fund. The Committee, however, could not push through the work entrusted to it for various reasons, one of which was the transfer of most of its members from Coimbatore to the Circles. We find that there has been some activity again and it is but appropriate that something is being done during this year's College Day Celebrations. We are glad to learn that a portrait in oil has been prepared which will be unveiled on the 30th of July by Rao Bahadur D. Ananda Rao, Director of Agriculture, who is about the oldest still in service and who had heen in closest touch with Mr. Wood's activities in Madras. We understand that the presentation of Mr. Wood's portrait to the College is only one of the several ways in which the Committee propose to keep his memory green. The fulfilment of these undertakings will have to depend naturally upon the active support given to the Committee by all those who had promised their support, and we are sure this will be forthcoming in an ample measure.

Mr. Wood was the first President of the Union and during his long stay in Coimbatore as the Principal and Ex-officio President, he did a lot in helping the Union to further its activities. We take this opportunity to make an earnest appeal on behalf of the Memorial Committee to all Mr. Wood's students, colleagues and friends in the Department to come forward with liberal donations so that the Committee may accomplish its desires without any further delay.



P. echinurus. *P. typhoides.*

BRISTLED CUMBU (PEARL MILLET)

BY G. N. RANGASWAMI AYYANGAR, B.A., I.A.S.,

&

P. V. HARIHARAN, B. Sc. (Hons.)

Millets Breeding Station, Coimbatore.

The earhead of *cumbu*, the pearl millet (*Pennisetum typhoides*, Stapf and Hubbard) is composed of a number of fascicles seriately disposed along a central rachis. Surrounding the spikelets in each fascicle is a whorl of 30—70 (average 40) free bristles. One of these bristles is thicker and longer than the rest and is called the "principal" bristle.[1] The morphological nature of this principal bristle has been discussed elsewhere and set down as the prolongation of the fascicle axis.[2]

The earhead of the commonly cultivated *cumbu* has a smooth surface and can be called bristle-less, the principal bristle keeping down to the grain surface. In *P. leonis*, a form of this millet from Sierra Leone, the bristle is even below the grain surface, so that the grains touch each other so closely as to give a very packed earhead.[3] A third condition is met with in a few varieties which are noticeably bristled. (Vide illus.) Bristled *cumbu* is much in demand for the reputation that it has for keeping off birds from pecking the grain. Bristled varieties are not very common in South India though in odd places in and outside this presidency there exist bristled forms.

To study the inheritance of this bristled condition, some bristled varieties were got down. Of these *P. echinurus*, an African species is "very bristly".[4] Its bristles measure on an average 2 cm. beyond the grain surface. Its chief disability is the tendency to shed spikelet whorls and this weakness might have militated against the perpetuation of very bristly types as economic varieties. That the reduction in bristles, both in number and in length, has kept pace generally with the packing of the grains on the earheads will be obvious from *P. leonis* which has the densest ear and the shortest bristles. Counts of fascicles and grains on a 2 inch length, an inch above the base of the earhead, of similar sized earheads (5 in each) have given on an average 943 fascicles and 1,521 grains for *P. leonis* and 502 fascicles and 1,028 grains for *P. echinurus*. It looks as if the spike-like disposition of the fascicles and the accommodation of both the grains and the obtrusive bristle brush on them, cannot go together with advantage.

These two species represent extremes in the length of the principal bristle and are constant in their expression. In order to get some idea of the genetic relationship of these two classes of bristles, "suppressed" and "very bristly", crosses were made between *P. leonis* and

P. echinurus and the F_1 was very bristly. In the F_2 there was a segregation for bristles, visible and suppressed. The lengths of the visible bristles ranged from short to medium and on to "very bristly". The groups ran one into the other so much that a sharp separation was not possible. All the visible bristles were, therefore, grouped together. The segregations obtained are presented below.

Cross No.	F_2 Family Nos.	Segregation for bristles Visible.	Suppressed.
P. T. VI.	P. T. 604	82	30
	,, 607	107	35
	,, 608	108	35
	,, 609	105	33
	,, 610	98	28
	,, 612	124	31
P. T. IX.	,, 616	78	25
	,, 619	100	29
	,, 620	44	16
	Total	846	262
	Expected 3 : 1	831	277
		$X^2 = 1{\cdot}08$	$P > {\cdot}05$

Though difficult of sharp classification through definite counts the bristled group could be broadly classified into full, medium and short. The average number of fascicles and grains in a 2 inch length in four typical earheads in each class of bristle length at corresponding portions, is given below.

Earheads with	Number of Fascicles.	Grains.
Full bristle.	731	617
Medium bristle.	895	1231
Short bristle.	981	1419
Suppressed bristle.	1156	1702

The above figures show that with the reduction in the bristle length the earheads get denser in fascicles and grains until in the heads with suppressed bristle they are at a maximum. The reduction in the number of grains per fascicle in the full bristle group is very significant.

In the collections of *cumbu* at the Millets Breeding Station there were some from Bellary (*P. typhoides*, Stapf and Hubbard) that had small bristles. These occurred in a population in which the bristles were suppressed. The slight bristled heads bread true and had non-shedding fascicles. Counts were taken in 2 inch lengths at similar positions in both the groups of earheads and the following average numbers of fascicles and grains were obtained.

Bellary *Sajja* (*Cumbu*).

	Suppressed bristled.	Slightly bristled (0·5 – 1·0 cm.)
Number of fascicles	567	435
Number of grains	1189	828

It will be seen that though there is no shedding with the shortening of the bristle, the obtrusive bristles have affected grain density in the earheads.

P. echinurus is said to be "bird-resistant, the bristles pricking the eyes of birds which attempt to extract the seed from the heads";[4] and this has been the experience with this millet at the Millets Breeding Station, Coimbatore. Its chronic shedding, the long thick bristle and the associated vigour of the other minor bristles of the whorl and the consequent reduction in the number of grains (which is the all important end in view) militate against its spread as a cultivated variety, however desirable and helpful, the long bristle may be. It is, therefore, not surprising that through the selective forces of man exercised in the course of centuries the very short and suppressed-bristled and denser headed forms have formed the predominant group among the cultivated *Pennisetums*. Breeding to avoid the scaring of birds is thus beset with other economic disabilities.

Summary. Bristled earheads of *cumbu* help in preventing birds from pecking the grain. In the varieties studied, the longer the bristle, the greater the shedding of the fascicles and the lesser the density in the packing of the grain. The condition in which the bristles are suppressed in expression and remain below the grain surface is recessive to that in which the earheads show bristles of lengths from short to full.

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CATTLE IMPROVEMENT IN COIMBATORE DISTRICT

By D. G. MUNRO, B. Sc.

One of the quickest methods of improving cattle is to arrange for the supply of a sufficient number of high class bulls. These mated with good cows will further improve the stock and when mated to cows of poor quality and mixed parentage will grade up the stock considerably in a few generations. The improvement of stock is a long term process and consequently calls for well-laid plans which will be continued over a period of at least 15—20 years.

The problem of bull supply resolves itself into three major parts. Firstly, the supply of bulls, secondly the cost of purchase of bulls and their distribution and thirdly the maintenance of the bulls during the years when they are at stud.

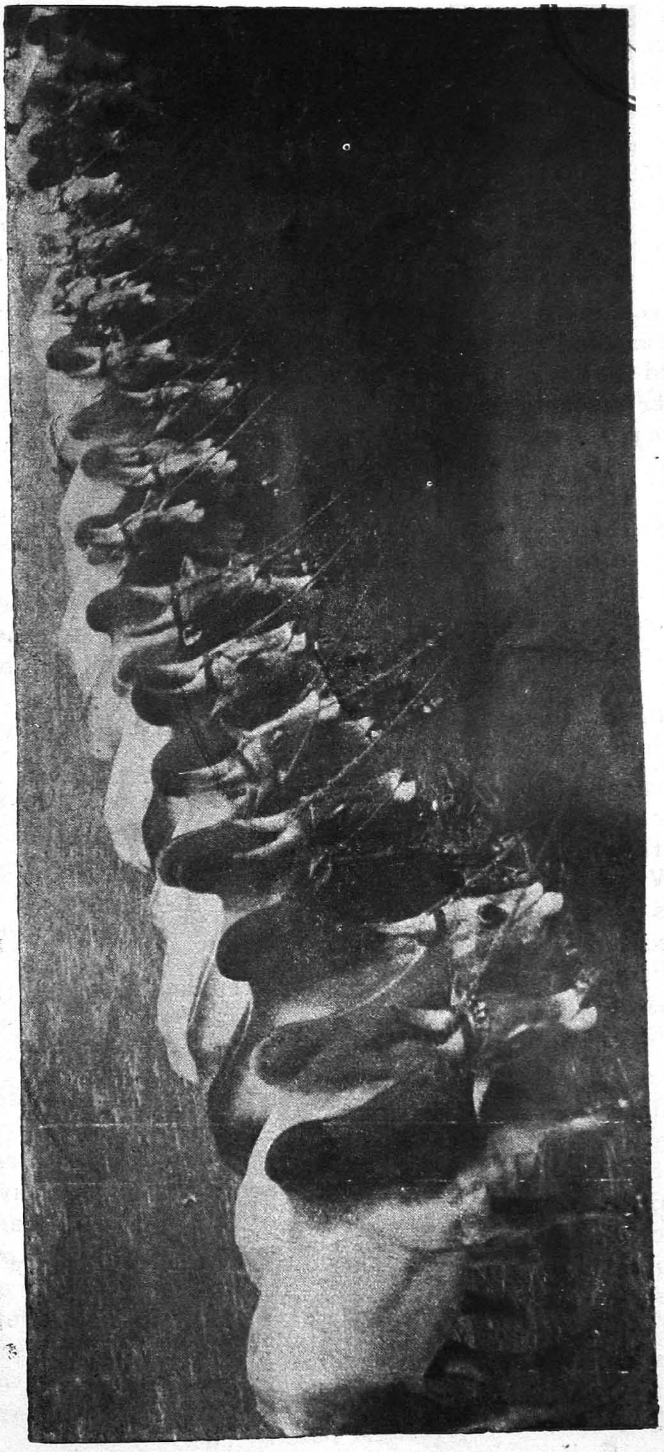
Supply of Bulls. Coimbatore district is fortunate in that it possesses a suitable and hardy breed of cattle—Kangayam—and a master in the art of breeding in the Pattagar of Palayakottai.

There is therefore a nucleus bull supply of at least 100—200 per annum, but is this sufficient ? In Coimbatore and Salem districts alone, there are nearly 1,000,000 breeding cows. At 100 cows per bull, 10,000 bulls are required for these two districts alone mostly Kangayam and partly Mysore breed. On this basis, no further arguments need be given for the necessity to increase the supply of high class stud bulls.

Purchase of Bulls. The business of producing and rearing high class stud bulls is a costly one. All cows do not give the same quality calves and only the best of the bull calves in a herd are kept for stud bulls. The remainder are castrated for work bullocks. It has been argued that as good cart bulls can be purchased for Rs. 150—Rs. 300 per pair, stud bulls should not cost Rs. 150 to Rs. 300 each. Every man however expects the best price for the best animal and as the stud bulls are the pick of the season's calves, they should naturally be higher priced. If a bull performs 50 services per annum for 3 years = 150 services, let us take 120 calves as the result. A good bull will easily increase the value of each calf by Rs. 5 to Rs. 15 or an average of Rs. 10. The resulting increase in livestock wealth on this calculation is Rs. 1200 or 4 times the value of a Rs. 300 purchase price. The bull is still fit for further service or he may be castrated and used as a work animal. In evaluating a stud bull therefore, it should be borne in mind that not only is the animal itself being purchased, but also the increased value of the calves produced by it and a normally Rs. 300 bull is in the long run cheaper than a Rs. 100 bull.

Maintenance. The cost of maintaining a bull for a year varies with the locality. Where all fodder and concentrated foods are purchased in the market and a special attendant paid for, the cost is very high. Where the bull is maintained by a ryot producing his own fodder and his cattle attendant gives part time attention to the breeding bull, the cost may go down to Rs. 10 to Rs. 12 per mensem. When the District Board, Coimbatore paid maintenance charges, the cost went as high as Rs. 22—8—0 per mensem or Rs. 270 per annum, roughly the value of the bull himself.

Service fees are charged at rates varying from annas four to rupee one and considerable difficulty has been met in persuading ryots that any service fee at all should be paid. This presumably is the result of the Brahmini bull free service scheme in existence in former days. Bull schemes organised on more materialistic lines however demand that those who receive the benefit i. e., the ryots whose cows produce better calves, should contribute to the cost of maintenance and the most equitable manner of distributing such costs is by the levy of a service fee. If a bull does 50 services and the cost of maintenance is Rs. 150 per annum, to meet the maintenance charges alone, Rs. 3 as service fee is required. In Mysore in the Hallikar breeding tracts, a service fee of Rs. 2 to Rs. 5 is willingly paid by the ryots.



Government and District Board Schemes. About 10 years ago, the Agricultural Department introduced the premium scheme for breeding bulls whereby for a stated number of services a premium of Rs. 100 each would be paid annually towards the cost of maintenance of the bulls. 3 bulls were started in 1928 with Co-operative societies. Leaflet No. 2 of the Department of Agriculture gives information in regard to this scheme. The District Board also purchased some bulls and put them out with individuals and paid maintenance charges. An examination of the results in 1933—34 led to the conclusion that instead of paying maintenance charges or premia, it would be advisable to spend the money available annually in the purchase of bulls. These bulls are placed out with land-lords and ryots, who undertake to maintain them at their own cost as breeding bulls for 2 years and do 50—60 services per annum. At the end of two years, the animals then become their own property. The bulls are inspected and reported on quarterly by members of the Agricultural and Veterinary Departments and any defects in the bulls or their manner of maintenance are reported. The main difference between these schemes is that in one case the subsidy is paid as a premium towards maintenance charges and in the other case, the available money is spent in the purchase of bulls. One great advantage of this latter method is that at the time of purchase the bulls are selected by experts and a high standard of quality is ensured. The scheme is working satisfactorily and no difficulty is now found in getting men to take the responsibility in regard to their maintenance and carry out the necessary conditions. There are now 45 bulls (1935—36 = 22 and 1936—37 = 23), included in this scheme and 19 bulls under the Government premium scheme, 7 of which are maintained by Co-operative societies and the remainder by private individuals.

When propaganda was first started in regard to the necessity for breeding bulls, many arguments were put forward by the ryots against it. Now however, there is no argument as to the value of good bulls and more attention is being given to ways and means of raising the money to purchase and maintain them. The results are now obvious.

What of the Future? Cattle power today has more competitors than in the past. Railways and Motor lorries are becoming greater competitors for goods transport. Engines and electric motors with pumps are replacing mhotes for water lifting from wells. Therefore with greater competition cattle, if they are to hold their own, must become more efficient and no inefficient and poor cattle should be produced or reared at all. The supply of good breeding bulls must therefore be increased and the work intensified. As already pointed out long term schemes are required and if large subsidies from Government and Local bodies cannot be given, the cattle industry itself will have to bear the increased cost by paying larger service fees.

Milk Production. Up to the present we have dealt mostly with work cattle. The necessity for improvement of cattle for milk production cannot be overlooked. The Coimbatore District Board has already accepted a scheme for placing at stud Scindhe and Delhi buffalo bulls.

With increased industrialisation in large centres like Coimbatore, a larger number of people will cease to have any connection with the land. Nutrition experts point to millk as one of the most essential and perfect foods. The first stage in increased milk supply is the breeding of stock which will produce more milk. The question arises as to where such bulls should be stationed. Some say in the larger towns, others in the villages. Possibly at the present time, there are more milk cows in the larger towns than in the districts and to serve these cows the bulls should be placed there. But what about the calves? In towns they certainly do not get the attention or food required. It is also probable that as the Health authorities become stricter, the number of cows maintained in the larger towns will be decreased on the score of health and cleanliness. In the near future therefore, it is likely that the villages in the neighbourhood of large towns will become the dairy industry and dairy stock breeding centres and milk and milk products only will be transported to the large centres.

The displacement of work cattle by power for lifting water etc., will make room for milk cattle and these will produce the essential Farm yard manure to maintain soil fertility and at the same time pay for themselves by production of milk.

INHERITANCE OF GRAIN SHATTERING IN RICE (Oryza sativa).

By K. RAMIAH & K.* HANUMANTHA RAO

Introduction. Shedding or shattering of grain is an important economic character in rice. In cultivated rices this causes a serious loss during harvest and the loss is estimated to vary according to the locality and the varieties, from as low a figure as 5% up to 30%. The firmness with which the ripe grain is attached to the rachis varies widely in different varieties. Wild rices exhibit this character to the maximum extent, the grains here falling away at the slightest impact of wind, even before they are fully ripe. In certain provinces where the cultivated rices get hybridised with wild rices through natural agencies the problem of shedding becomes a serious one. Some of the progenies of these crosses look for all practical purposes like the cultivated types but have the badly shattering character of the wild rice in them. Since it is not usually possible to identify them and eliminate them in the early stages, they form a permanent source of

deterioration of the crop. Bhalerao (1930) surveyed Mallnad tract of the Southern Division in the Bombay Presidency and has suggested remedial measures against these 'Gonags' or cultivated rices showing this wild character.

Among the cultivated rices, in some, the grains fall off very easily in the field itself during harvesting operations, while in others, like some of the Burma types in our varietal collection, the grains are so firmly attached to the rachis that threshing becomes a difficult operation. The ideal variety of rice should be one that does not usually shatter in the ordinary process of harvesting but at the same time lends itself to easy threshing. The study of the inheritance of this economic character was taken up at the Paddy Breeding Station in the years 1932—34.

Literature. The inheritance of this character where both the parents belonged to the cultivated types has not been reported so far. But when one of the parents is a wild type, it has been found (unpublished records of the Paddy Breeding Station) that this behaves as a simple mendelian character, the shattering being a recessive rudiment.

In his anatomical studies, Yoshito (1928) has shown that shedding is due to the formation of a special abscission tissue in the part of the stalklet which lies between the empty and the glume rudiment. The time at which this tissue is formed varies with varieties. In some this tissue is formed very early and dries up before the panicle ripens and this premature drying up causes the grain to shed before the harvest. In others, this tissue begins to form long after they have flowered, and the crop is harvested even before this tissue gets fully developed. The time of formation of this abscission layer thus determines the nature of shedding.

Estimation of shedding character. (a) *Device.* The estimation of the degree of shedding, a quantitative character, is not quite easy. The only recorded attempt to measure this character quantitatively is that reported by Mendiola (1926). The principle of this method consists in dropping the rice panicle from a definite height over a wire mesh, the degree of shedding being measured by the number of grains shed from such an impact. The method of dropping involves difficulties in controlling the way in which the panicle falls, as the surface of impact of the panicle cannot always be the same.

The study of a number of families for the inheritance of this character led to the improvisation of a simple apparatus designed by the Junior Author (1935) and it has been found to give satisfactory results. The apparatus consists of an inclined plane over which the panicle to be tested for shattering is placed at a definite distance from the top edge and a weighted roller which is allowed to pass over the head. The number of grains shattered by the roller passing over the panicle is a measure of the shattering.

(*b*) *Materials and Method.* A preliminary rough examination of all the pure lines grown at the Paddy Breeding Station, was made to distinguish the shedding and non-shedding types. When the degree of shedding is expressed as a percentage of the shed to the total number of grains in a panicle, the number of grains shed and the total number of grains on the panicle have to be counted each time which involves considerable amount of labour. The only method of eliminating this difficulty was to select such parents for crosses which though they varied with regard to shattering, had about the same size and number of grains in the panicle. In the study of the families involving parents having such uniform panicles, the actual number of grains that shed was taken as an index of the measure of the degree of shedding.

The next step was to decide the minimum number of plants and the minimum number of ear heads in each plant that would have to be examined which would give a correct estimate of the whole family for the character. After some preliminary tests it was found that the shattering measured in one of the main panicles in each of 25 plants in a family gave a correct estimate of the character of the family.

There is also another difficulty which should bring in an error in the estimation namely that due to the degree of ripeness of the grain. Obviously for the measure of the character, panicles of the same age have to be examined. Since ripening depends upon the time of flowering the flowering dates of each plant were recorded in each of the families and the panicles were collected exactly 40 days after flowering, when the grains were found to be ripe.

The procedure adopted for the estimation of this character was as follows. The first thing was to mark the detailed flowering of the individual plants on a chart. By referring to this chart, plants, that flowered 40 days earlier were spotted out in the field. One primary earhead from each of those marked out plants was cut just below the neck or the ring of the panicle, early in the morning. All the earheads were carefully labelled and were uniformly dried in a tray for four hours. They were then placed over the apparatus one by one and the roller was passed. The number of grains shattered in each panicle was taken as the measure of the degree of shattering.

Inheritance Studies. *Parents*. One of the parents selected was T. 237, a non-shedding type where the number of grains shed ranged from 0—10 with a mean of $3{\cdot}54 \pm 0{\cdot}13$. The other parent was T. 389, a highly shedding type where the grains shed ranged from 17—56 with a mean of $34{\cdot}30 \pm 0{\cdot}53$ grains.

F_1. A cross was made between the above two parents T. 237 xT. 389, in the year 1931—32, and in 1932—33 the F_1 plants were grown. Since the device mentioned had not been perfected when the F_1 was ready, the degree of shattering was estimated only by beating the head

Table I.

Frequency of number of grains shed in F_2 and parents. (1933—34).

	Number of grains shed.															Total.	Mean number of grains shed.
	Nil.	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-40	41-44	45-48	49-52	53-56		
Parent T. 237	4	66	24	1	—	—	—	—	—	—	—	—	—	—	--	95	3·54 ± 0·1302
F_2 4482	-	59	134	108	104	63	30	24	7	5	1	2	—	—	--	537	12·34 ± 0·2057
Parent T. 389	-	—	—	—	—	5	10	17	13	18	14	12	9	3	3	104	34·30 ± 0·5344

Table II.

Statement showing the correlation betweeen the number of grains shed in F_2 and the mean number of grain shed in F_3 progenies.

Mean number of grains shed in F_3 progenies.	Number of grains shed in F_2.																					Total
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	
1—2			1																			1
3—4	1	10	8	12	6	2	2				1											42
5—6	11	16	20	15	13	13	11	6	4	4	...	2	1									116
7—8	6	11	16	21	14	9	14	17	7	4	2	...	2	2								125
9—10	1	3	10	9	15	13	13	9	12	5	5	4	4									103
11—12	...	2	2	3	6	5	6	6	9	3	5	1	3	3	1	1	1	1	...	...	1	59
13—14	...	...	2	...	2	...	1	3	4	7	1	2	4	...	1	1	...	...	...	1	...	29
15—16	...	...	...	2	...	...	1	5	...	2	...	1	1	...	2	1	...	...	...	...	1	16
17—18	...	...	...	2	...	...	1	...	...	...	3	...	1									7
19—20	...	...	...	...	1	1	...	...	...	1	...	2	2	...	...	...	...	1				8
21—22																		1				1
23—24																						...
25—26																						1
27—28																						1
Total.	19	42	59	64	57	43	49	47	37	26	17	12	18	5	4	3	1	3	...	1	2	509

Parental means.		F_2	F_3
	T. 237	3·5	2·9
	T. 389	34·3	25·0

Correlation $r = + 0·48 \pm 0·023$.

on the palm and it was found to be intermediate between the two parents.

F_2. In 1933—34 all the seeds from one of the selfed F_1 plants were sown, and 600 F_2 seedlings were planted in lines one foot either way. 150 plants of each of the two parents were also planted in lines on either side of the F_2 population. Detailed flowering was marked for all the plants individually. Shedding was estimated as described already. The results obtained are given in a tabular statement (Table I).

F_3. In 1934—35, the whole F_2 population was carried forward for the study of F_3 behaviour. In each lot, 100 plants were planted in three rows 1′ apart and 6″ in the row. Here also general flowering was marked for individual families and the estimation of shedding was done with reference to those dates. 25 plants were examined in each family.

From the readings collected, first the mean number of grains shed in the F_3 families, the standard error and the percentage standard error were calculated. The coefficient of correlation between the number of grains shed in F_2 and the mean number of grains shed in the respective F_3 families was determined (Table 2).

Analysis and Conclusion. F_2 ratios do not indicate any simple inheritance. The mean number of grains shed per panicle for the two parents are 3·54 and 34·3 respectively whereas the F_2 mean is 12·34, intermediate and tending towards the nonshedding parent. The greater variability and the distribution of the F_2 population indicate that more than one factor is involved in the inheritance of this character.

In the F_3 we find that there is a significant positive correlation between the number of grains shed in F_2 and the mean number of grains shed in F_3, the coefficient of correlation, *r*, being $+0{\cdot}48 \pm 0{\cdot}023$. This is an indication that the factors involved in the inheritance of this character are not many.

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GINGER CULTIVATION IN AND AROUND KALUVOY

BY A. VENKATARANGAM,

Agricultural Demonstrator.

Cultivation of ginger is to be seen round about Kaluvoy village of Atmakur Taluk; but is not extending further; the soils and the undulatory nature of the land here are said to contribute to the successful cultivation of ginger. The crop does not seem to come up well on mere plains. It requires *Kondachāluva nela* as they put it—i.e., hill-side villages with rich loams having good drainage facilities and water supply for 10 months in the year.

Preparatory Cultivation. The land is ploughed 10 to 12 times to get good tilth; ridges are then formed lengthwise 14 inches apart. The field is next divided into beds of uniform size of 4 yards × 18 yards for forming irrigation channels lengthwise and breadthwise. Thus each bed will have about 10 ridges 18 yards in length. This is the usual method adopted; but there will be variations seen in the size of beds depending on the contours of the field.

Planting. Planting is generally done in May or beginning of June. Ginger removed fresh from the field is not used for seed-purposes; but is allowed to wither for a month or two in shade. During this period it is kept in heaps which are disturbed now and then; one or two days before planting, this seed ginger is cut into pieces having two or three internodes.

At first a mixture of *agathi* (*Agathi grandiflora*) and greengram (*Phaseolus mungo*) seeds are dibbled at the top of the ridges with 12 inches spacing, the seed rate of agathi and green-gram being 20 and 14 lbs. respectively per acre. Water is then let in and the space between the ridges is flooded. Next day when soil gets into the right condition, (i.e., without getting sticky) ginger is planted on one side of the ridges in a line with the points, where agathi and green gram seeds are dibbled and also on one side of the irrigation channels with the same spacing; The seed rate for a ginger crop is 40 to 50 maunds per acre. After planting is over, manuring is done, generally on the same day, by top dressing with about 50 cartloads of cattle manure or sheep manure or mixture of both per acre. The sowing of agathi and green-gram is to give enough shade to the tender ginger crop, which takes about one month for complete germination; by this time agathi and green-gram grow sufficiently thick to give the requisite shade. Depending on weather conditions irrigation is generally given once in a week until the crop matures.

After-Cultivation. Hand weeding is commenced generally 10 days after planting and is done frequently until the crop is about 4 months old, by which time the crop covers the ground and there is no necessity for hand weeding.

After one month, the green-gram is pulled out and fed to cattle, as *aguthi* alone would do well to give the required shade to ginger crop. After two months, thinning and topping are done in agathi lines to regulate the shade ; by frequent toppings, agathi plants are not allowed to grow more than a man's height. Just at the time when the thinning of agathi plants is begun, "*Thangedu leaf*" (*Cassia auriculata*) is brought in sufficient quantities and spread between the lines of agathi and ginger plants. After these leaves are dried up, the *thangedu* stalks are removed and the dried leaves are worked into the soil by hand hoeing and earthing up between the lines.

Harvesting. After ten months i. e., about the month of March, the crop can be removed, the maturity of the crop being noticed by the drying of the leaves. The crop is to be removed soon after the leaves are dried (i. e., in about 15 or 20 days); otherwise the rhyzomes become unfit for seed purposes, as they begin to germinate again. If it is allowed to germinate again (as is done actually in some places) it has to be kept for six months more i. e., till the month of October, when the yield will be nearly doubled. The yield of 10 months crop is about 400 maunds of green ginger or 10,000 lbs. per acre ; while the yield of 16 months crop is about 19,000 lbs. of green ginger per acre.

The local merchants purchase the produce at about Rs. 2 per maund and export the green stuff, as it is, to Northern Circars ; but no curing is done here nor is it known in these parts.

The gross income for the grower from a short term crop, i.e., 10 months crop is about Rs. 800; while that of a long term crop is about Rs. 1500 per acre in all normal years. The cost of cultivation for 10 months crop, as given below, shows a total expenditure of Rs. 250 per acre, including cost of seed and manure thereby giving a net income of Rs. 550 per acre ; while in the case of 16 months crop the net profits are expected to be about Rs. 1150 for in this case, the grower has no other expenditure except keeping on the crop under well irrigation during summer, for which item a liberal sum of Rs. 100 has been allowed under cost of cultivation.

General. The Rhyzomes of long term crop are said to be unfit for seed purposes. Ginger is also cultivated in Kothur village on Cuddapah borders in Rajampet taluk and the produce there is said to be the best for seed purposes. Hence the growers at Kaluvoy renew the seed once in 3 or 4 years with fresh supplies from Kothur a distance of 15 miles from Kaluvoy.

Cost of cultivation of short term crop of Gingelly per acre.

Preparatory cultivation.

Ploughing 12 times—24 pairs at Re. 1/- per pair. ...	24 0 0	
Forming ridges—one pair at " " ...	1 0 0	
Forming beds and irrigation channels—2 men at 6 annas per head	0 12 0	
		25 12 0

Manures and manuring.			
50 cartloads of cattle manure at Re. 1/- per cartload	...	50 0 0	
Spreading the above—6 men at 6 as. per head.	...	2 4 0	52 4 0
Seeds and sowing.			
Dibbling agathi and greengram—2 men at 6 as. each	...	0 12 0	
Cost of 10 seers of agathi and at 10 seers per rupee.	...	1 0 0	
Cost of green-gram 6 seers at 12 seers per rupee.	...	0 8 0	
Cutting ginger and planting—6 men at 6 as. per head.	...	2 4 0	
Cost of ginger seed 50 maunds at Rs. 2/- per maund.	...	100 0 0	104 8 0
After-cultivation.			
8 weedings including thinnings	...	10 0 0	
Cost of 20 headloads of "Thangedu" at 2 as. per headload.		2 8 0	12 8 0
Irrigation.			
Tank irrigation supplemented with well irrigation during summer (8 well-irrigations at Rs. 3/- per irrigation).	...		24 0 0
Harvesting.			
Digging tubers at Rs. 15/- per acre.	...		15 0 0
Contingencies	...		16 12 0
	Total Rs.		250 0 0

Research Notes.

A remarkable emergence of a Pempheres parasite.

An unexpected emergence of a large number of Braconid parasites (Spathius Sp.) from a cage of wilting cotton stalks under observation was discovered for the first time on 20th March 1936. This Braconid is already known to be a definite parasite of the larval stages of the cotton stem weevil—*Pempheres affinis. F*, and the same has been observed and collected from several places like Coimbatore, Ramnad district and Erode. The emergence continued for over a month and a half though irregularly and in diminishing numbers. About five hundred parasites have thus been collected.

It was strongly suspected at the time that an alternative host was involved in this mass emergence. But no satisfactory and conclusive evidence in regard to its true host relations was forthcoming at the time. As a result of careful studies and actual collection of the host stages and adults it is now definitely seen to be a specific parasite of a Bostrychid—Sinoxylon sudanicum Lesne.

P. N. Krishna Ayyar, *Parasitologist.*
P. S. Narayanaswami, *Assistant.*

Mendelian Segregations for Juiciness and Sweetness in Sorghum Stalks.

In a previous article* juiciness and sweetness in the stalks of sorghum have been reported to be independent, heritable characters. A number of segregations for these characters have been noted for each separately and in combination. A factor D is responsible for dry pithy stalks ; d produces juicy stalks. A factor X results in "not sweet" stalks ; x results in sweet stalks. D and X are independent in inheritance. The Mendelian segregations obtained are presented below :

* Rangaswami Ayyangar, G. N., Juiciness and Sweetness in Sorghum Stalks. *Madras Agricultural Journal* 23 (9) Pp. 350—352. 1935.

Table I.

Pure for Sweetness (xx), *Segregating for Juicy Stalks* (Dd).

	Stalk—Pithy DD and dd (Midrib—White)	Stalk—Juicy dd (Midrib—Dull)
Totals of 24 families grown in Nandyal, Hagari and Coimbatore.	1644	689

Table II.

Pure for Juicy Stalks (dd), *Segregating for Sweetness* (Xx).

	Stalk (Pure Dull Midrib) Not Sweet (XX and Xx)	Sweet (xx)
Total of 12 families	1176	392

Table III.

Pure for Pithy Stalks (DD), *Segregating for Sweetness* (Xx).

	Stalk (Pure White Midrib) Not Sweet (XX and Xx)	Sweet (xx)
Total of 5 families	545	206
Expected (3 : 1)	563	188

$X^2 = 2{\cdot}298$, $P > 0{\cdot}10$.

In crosses between a pithy stalked sweet variety and a juicy stalked "not sweet" variety the first generation was pithy stalked and "not sweet". The following di-hibrid segregations have been obtained.

Table IV.

Di-hybrid segregations for Pithy and Juicy stalks and for "Not Sweet" and Sweet.

	Stalk—Pithy (DD and Dd)		Stalk—Juicy (dd)	
	Not Sweet (XX and Xx)	Sweet (xx)	Not Sweet (XX and Xx)	Sweet (xx)
Total of 5 families	917	348	342	115

In further selections the economically poor combination of pithy stalks "not sweet" has been fixed and is breeding true.

Millets Breeding Station,
Coimbatore,
July 18, 1936.

G. N. Rangaswami Ayyangar.
M. A. Sankara Ayyar.
V. Panduranga Rao.
A. Kunhikoran Nambiar.

Correspondence.

To The Editor, Madras Agricultural Journal, Coimbatore.

Sir,

With reference to the letter of the Parasitologist, dated 11--6—'36, I have great pleasure in answering the points raised by him.

As the monthly reports of the Parasitologist are not published for the benefit of other entomological workers, I was unfortunately unaware of the items of "new knowledge" which he claims to have reported about, when I sent my note for publication to the Editor of the M. A. S. U.

To the claim of priority advanced by the Parasitologist based on his monthly report for December 1935, I take leave to give the following extract from my monthly report for December 1933:—"During the month, when the Cotton Specialist was camping here, I drew his attention to the fact that Pempheres was present here. Since then, I have noted adults on *Hibiscus esculentus* plants very constantly and the examination of a few available old plants gave evidence of heavy Pempheres infestation on the stems. I have not come across any infested cotton plants so far". This fact was observed even earlier by Mr. P. S Narayanaswamy, my predecessor at Taliparamba; though he has to my knowledge, not reported about this, I have with me Pempheres specimens collected by him from *H. esculentus* plants. I may also enlighten the Parasitologist that there was some correspondence on this subject between the Cotton Specialist and myself.

The joint paper quoted by the Parasitologist is a resume of the experiments and observations arrived at by the authors after the first two years of work at Coimbatore and was presented at the College Day and Conference in October 1933. The observations recorded in my note were made after my subsequent transfer to Taliparamba.

The inquiry of the Parasitologist to the Farm Manager, Taliparamba, was whether he could see the plants which he had listed in the farm. When the Farm Manager consulted me about this I informed him that I was not aware of the availability of these plants either inside the Farm or near-about. The Farm Manager's reply must have been a natural corollary of this information, since he could not expect a pest to be present in the absence of the host plants.

I am extremely pained to note the general trend of the remarks of the Parasitologist which, to qualify even mildly, is unhealthy.

Agricultural Research Station,
Taliparamba, 2—7—'36

E. R. Gopala Menon,
Entomology Asst.

To The Editor, Madras Agricultural Journal, Lawley Road P. O.

Sir.

I think a word or two might be said about the host plants of *Pempheres affinis* other than cotton. As early as 1909 Lefroy, in his Indian Insect Life, (page 389) says that the weevil is common in the stems of malvaceous plants, attacking cotton severely but he does not specify the names of these other malvaceous plants. In the Proceedings of the 2nd Entomological Meeting, Pusa, 1917. (page 125), Fletcher mentions that Pempheres occurs in bhendi plants (Hibiscus esculentus) at Pusa and is probably widely distributed but overlooked. Dr. Ramakrishna Ayyar has mentioned the occurrence of the weevil in bhendi in the Madras Year Book (1918) and the Proceedings of the 3rd Entomological Meeting, Pusa, (1919). Ballard in his paper on "Further notes on Pempheres affinis, Fst. the cotton stem weevil" published in Vol. VII No. 12 of the Pusa Memoirs (1923) states the weevil has been bred from Hibiscus esculentus and other malvaceous plants. Since then Dr. Ramakrishna Ayyar has expressed doubts as to the correctness of Mr. Ballard's statement for, as late as October 1934 he states "I do not believe that the weevil has been found to breed on any other plant than cotton.' I would therefore welcome Mr. Gopala Menon's statement that he has bred the weevil from *Hibiscus esculentus* as it re-establishes the correctness of the original observations.

I would also like to bring to the notice of your readers another point. To me, Mr. Menon's main idea in publishing his observations seems to be to emphasize the fact that Pempheres though found in bhendi was absent from the

varieties of cotton grown in the farm. Perhaps, a detailed study of this problem may help to trace the original host plant of Pempheres.

Regarding the two points raised by Mr. Krishna Ayyar (non-inclusion of bhendi as an host plant in the joint paper and the Farm Manager's reply) and Mr. Gopala Menon's reply I leave it to the readers of your valuable journal to judge these on their own merits.

M. C. Cherian,
Government Entomologist.
13-7-'36

STOCK REARING IN THE TROPICS

Management of Cows. All cows are dried off six weeks before calving, or earlier, if their milk yield drops below 25 lb. When a cow is dried off, she may be given a dose of 1 lb. magnesium sulphate, though usually this is not necessary. She is then drafted into the dry cow herd, where she remains on dry cow rations until a month before she is due to clave. She then returns to the milking herd, and comes into the milking shed twice daily, along with the milking cows, and receives milking cow rations on the basis of a yield of two gallons. If she has had a calf before, she requires no further attention before calving, but if she is a calving heifer, or a known heavy milker, she has her udder washed and massaged twice daily, and is lightly milked for a week before calving. Such ante-natal milking should, however, be done very gently and care should be taken to avoid causing pain and consequent apprehension.

A good deal of importance has recently been attached to this question of pre-natal treatment at Pusa, where experience with the Sanhiwal herd has indicated not only a considerable increase in milk yield, but also a remarkable freedom from udder trouble. It is claimed, as an additional advantage, that this treatment makes the cow much more amenable to letting down her milk without the calf. It is not considered at Shika that at present this question is one of much importance. All that is wanted is to secure that the mammary glands are stimulated sufficiently to start secreting fully and immediately the cow calves. It would be most beneficial no doubt, in the event of any congestion of milk, sufficiently great to be likely to cause udder trouble, but this is of extremely rare occurrence with native cows. It is not considered therefore that the practice is worth the amount of extra work involved. By keeping a calving list, prepared month by month, some time ahead, it is possible to ensure that all heifers due to calve come up for observation in due course.

One week before an animal is due to calve, she is transferred into the calving pen. This should be kept very clean, the walls whitewashed after each calving and soiled litter removed daily. During this week the cow is given an extra supply of *dusa* * to keep her bowels free, and if there is any sign of constipation, she should be given ¾ bottle of linseed oil.

At birth the calf's cord is not ligatured but is cut off, washed with a lysol solution and painted with iodine. Previous experience with tying the cord has been unfortunate. The afterbirth should come away of its own accord within 24 hours, but no action need be taken up to 48 hours. If at the end of this time it is still adhering, it has been found of assistance to twist the end of the afterbirth round a piece of stick and by twisting, exert slight pressure. This twisting should be increased hourly or a small weight attached, and in nearly every case the afterbirth will come away by itself. On no account should attempts be made to hasten its exit by hand, as it is most likely that inflammation will

* Bran of guinea corn (Andropogon sorghum).

ensure, and the cow almost certainly become barren, while there is a considerable risk of the operator getting an unpleasant skin infection.

Up to a few months ago, it was the custom to leave the calf with its mother for two days and two nights and not start milking proper until the third day. (Every cow, of course, is milked a little immediately she calves, in order to ensure a free flow for her calf). This practice has been criticised on the ground that it leads to the holding up of milk and reacts adversely upon the cow's ultimate yield. On the other hand, it is held by some that by removing the calf from the mother at birth, its health was being prejudiced, by its being deprived of its natural self-prescribed ration of *colastrum*. However, the length of the suckling period has been gradually reduced, without apparent harm to the offspring, and at the time of writing, all calves are removed from their dams at birth. Instead of *colostrum* the calf gets a laxative on the first three days of its life: on the first day one tea-spoon of linseed oil, on the second day the same plus one tea-spoon of castor oil; on the third day the castor oil is increased to three tea-spoonfuls. This amount of laxative seems to get rid of the *meconium* fairly well, and since the wellfare of the calves is the major concern at Shika, the new routine is firmly established.

When the cow calves she continues to receive rations at the rate proportional to a two-gallon yield. In actual practice, she is fed *ad lib* for some four weeks after calving, or until such time as she has definitely passed the crest of her flow. One's aim should of course be to reach that maximum as quickly, and to maintain it as long as possible. This can only be done by giving every newly-calved cow individual attention, and by breaking down any tendency on her part to hold up her milk by milking her frequently. With calving heifers, it is often necessary to milk up to ten times a day, before one can be certain that no milk is being withheld, and *all* cows are milked at least five times daily for the first three weeks of their lactation period. In spite of all care, blind quarters are occasionally found, and experience here is that it is better to get rid of such animals at once, as treatment is nearly always unsatisfactory. It is difficult, if not impossible to cure, and there is no known formula for making the necessary correction in the record of the cow's milk yield. Care is taken to see that as soon as a cow's milk yield drops, her ration are proportionately reduced, as otherwise she is simply putting on unnecassary fat.

Calf Rearing. When the calf is taken away from its mother it is put into an individual calf-pen and well bedded down. Each pen has a ticket showing weight at birth, and weekly increase of weight. The calf remains in these pens for one month or until it has to make room for a new arrival. During that period it receives its mother's milk at least three times per day. If the cow will let down her milk without her calf so much the better and this is a tendency which is very strongly encouraged. Roughly, the following quantities of milk are fed to calves :—

Birth to one month	...	5 lb. per day.
1—2 months	...	6 ,,
3—4 ,,	...	8 ,,
5—7 ,,	...	10 ,,

These quantities vary with individual cases, and it is better during the first month of a calf's life to err on the light side, as a calf's stomach is unable to cope with large quantities of milk. The milk after being drawn from the cow is heated up to blood-heat before being fed. All calves have free access to bran from birth and although they seldom touch it during the first two weeks, it is advisable to have it there. The total amount of milk fed to a calf is about 175 gallons.

From the individual pens the calves are moved into a pen at the side of the milking shed, holding from four to six animals each. As soon as an individual pen is vacated the floor is washed out with a disinfectant solution, and the walls re-whitewashed before a new tenant enters. At one time the calves that had to go into the milking shed to induce their dams to let down milk, were segregated from those that never entered it, but this is no longer done. From these pens the animals move into one or other of three pens where they are graded according to size and age, a fourth pen is reserved for convalescent cases while they are segregated from their fellows. Good housing in the dry weather, when the diurnal variation of temperature is great, and the early hours of the morning quite cold, plays an important part in keeping the calves healthy.

The calves are drafted from this last series of pens when they reach eight months old, and here the first segregation of sexes occurs. Calves have in the autumn been drafted straight into the feeding experiment. but during the spring and summer months, the sexes are penned separately. The females are taken into the Dry Season Feeding Experiments, while the males out of inferior dams are castrated.

As soon as heifers are served they go into the "calving heifers" herd where they get special feeding as laid down in the table of rations.

In the early autumn (September) the castrated males are handed over to "mixed" farmers through the Superintendent of Agriculture concerned.

Before a calf is one month old it should be drenched once with turpentine and linseed oil against round worms (6 ozs. turpentine in 20 ozs. linseed).

After it is one month old it should be drenched against wireworms with copper sulphate and mustard at fortnightly intervals, at rates varying with weights. Drenching with copper sulphate and mustard every fortnight is routine for calves, sheep and goats throughout the wet season and up to the end of November. It is considered worth while drenching at 4-30 a. m. or earlier in order to give the drug a fair chance of acting before the morning milking.

The dangerous time of a calf's life is from birth till six weeks old. During that time they must be watched most carefully. The first sign of anything wrong is usually diarrhoea. When this occurs the animal should be put straight into the "hospital", dosed with castor oil, and not given any milk for 12 hours. If at the end of that time there are signs that the scour is lessening, small quantities of milk and hot water (50/50) may be fed at intervals of three hours, but the animal should not be put back on its full rations too soon In some cases this treatment will cure in a day or so, but unfortunately in the majority of cases, convalescence is a very long business entailing constant supervision. Many different measures have been tried, with varying success, but prevention is better than cure, and the secret of successful calf-rearing is considered at Shika to be cleanliness, cement floors, and absence of overcrowding until the calves are over two months old. Towards this end, it is essential, among other things, to see that all calves have clean litter, that the udder of each cow is properly washed before she is milked, that the calf's mouth is washed and dried after it has had its drink (this lessens the attacks of flies and reduces the loss of hair round the mouth), that milkers wash their hands frequently during milking time. and above all, that buckets should be well washed between individual milkings To avoid overcrowding, draft the biggest calves into the segregation pens as soon as possible.

External parasites (lice and fleas) need not be anticipated until the animal is two to three months old and is living on a floor of litter. A daily inspection of the animals should then be carried out and whenever lice are noticed, the stock should all be dipped with arsenic dip (1 in 250) in a small bath. At the same

time the bedding should be burned and walls re-whitewashed. Other dips have been tried such as emulsified soap and kerosene, tobacco and mustard, but Cooper's arsenic dip seems the most satisfactory. Care should be taken to see that young calves do not get chilled and therefore the dip should be slightly warmed, the animals should be dried afterwards, and the dipping should not be done very early in the morning

Feeding of Cows. The West African Zebu cow in the hands of the Fulani herdsman leads a nomadic life grazing from one part of the country to another, being forced by the drying-up of streams and water-holes to move southward as the severity of the dry season increases in the more desiccated north Poor as the natural grazing is known to be for eight months in the year, the Zebu cow exists on it alone and receives no concentrates. If she exhibits signs of 'pica', she may be given a littla native cattle 'lick', consisting of salts of soda and potash, but that is all. In these circumstances, reproduction entails a severe drain on her constitution and the loss in body-weight during her lactation period is appalling Among native owned herds, annual calving is exceptional, biennial and triennial calvers being the rule, and it seems fairly certain that this reluctance to breed regularly and often is an inhibition evolved by the animal through generations of privation, to combat the hard conditions in which she has her existence.

From investigations carried out among the Fulani, it seems accurate to state that the milk yield of their cows varies in inverse proportion to the periodicity of calving. One factor which practically by itself will upset this correlation, is the adequate feeding of balanced rations, and it has been proved at Shika that if this is seen to, the bulk of the cows will (and do) calve down regularly once a year.

The whole aim in fixing the rations of the breeding stock is therefore *so to maintain their condition that their milking performance is a true record of their capabilities.* This applies equally to young female stock as to mature cows, for if an animal's development is retarded at any period of its life prior to or during the time it is recorded, it not only affects its own record but masks the true value of its sire. All animals (except the working stock) are weighed at monthly intervals and an inspection of these weights enables one to see whether an animal is doing properly or not.

Feeding of Breeding Bulls and Working Bullocks. While a bull is running with a herd of cows, he is fed *ad lib*, regardless of season. This is to ensure that he keeps in good form, for if he allows a cow to come in season without serving her, then he is seriously affecting her record.

During the cropping season (April to August) all working beasts should be fed *ad lib.* They have to work very hard indeed, especially at the beginning of the season, and unless personal attention is given to their feeding they will be unable to stand up to their task. Their health must also be watched, and though fortunately at Shika, there has been very little serious sickness, apart from the usual sprains, cuts and abrasions that require no special mention, there is always the risk of trypanosomiasis. All likely breeding grounds are regularly cleaned and there is consequently no 'fly', but there is always the risk of mechanical transmission, in view of the fact that the majority of the animals here is purchased stock.

Liver flukes are however abundant, and a *post mortem* never fails to show this parasite or indications of its presence. All marshes and drinking pools are treated with copper sulphate (one part in a million) at three monthly intervals to kill the snail hosts. Animals that appear to be infected are treated with small doses of tartar emetic, only slightly more than half the doses generally recommended for animals suffering from trypanosomiasis. (From the *Tropical Agriculture.* Vol. XIII, No. 6 June 1936, pp. 151—153).

Crop and Trade Report.

Groundnut 1936—Summer and Early Crops. Sowings of the summer crop of groundnut and of the early crop in the districts of Salem and Coimbatore are generally satisfactory. Harvest of the summer crop of groundnut has commenced in parts.

The yield is expected to be generally normal. The wholesale price of groundnut (shelled) per imperial maund of 82 2/7 lbs. as reported from important market centres towards the close of June 1936 was Rs 6–1–0 in Cuddalore, Rs. 5—15—0 in Vizianagaram, Rs. 5—14—0 in Guntur, Rs 5—11—0 in Vellore, Rs. 5—10—0 in Negapatam. Rs. 5—9—0 in Cuddapah and Salem, Rs. 5—8—0 in Cocanada, Rs. 5—7—0 in Nandyal. Rs. 4—11—0 in Madura, Rs. 4—6—0 in Vizagapatam, Rs. 4—3—0 in Bezwada, Rs. 4—2—0 in Ellore and Rs. 3—6—0 in Tinnevelly. When compared with the prices in March 1936, these prices reveal a rise of 50 per cent. in Madura, 35 per cent. in Tinnevelly, 20 per cent. in Cuddapah, 15 per cent. in Nandyal, 14 per cent. in Ellore and Salem, 12 per cent. in Vellore. 10 per cent. in Guntur, 9 per cent. in Vizianagaram, 5 per cent. in Negapatam and 1 per cent. in Cocanada and Cuddalore and a fall of 20 per cent. in Vizagapatam.

College News & Notes.

The Students' Club. The general body meeting held on the 30th June 1936, elected the following office bearers for the working Committee of the Agricultural College Students' Club. Club Secretary, H. Krishnakumar. Games Secretary, S. K. Sastry. Cricket Captain. D. V. Rajagopalan. Hockey, V. Joseph dass. Foot ball, M. Mukundan. Tennis Representative, P. M. Sayeed. Class Representatives, III year, A. V. Pichumani. II Year, Agha Muhamad Bauker. I Year, Kunhirama Menon. On the 23rd the students of II year and III class gave a tea to welcome the 1st year and short course students. The members of the teaching staff, the tutors and the Secretary of the Union participated in the function. The representatives of the ii and iii year students made speeches welcoming the freshers and they were followed by the representatives of the tutors. members of the staff and the coaches, and the Secretary of the Union. The representative of the 1st year class replied in suitable terms. The Principal in a short speech emphasised the value of practical work in agriculture and advised the students not to neglect it.

Cross Country Race. The race was run on the 18th and S. V. Sastry was winner, Marthappakini II and Syinludian III.

Diamond Jubilee Celebrations. The various committees. formed in connexion with the College Day Celebrations are busy making arrangements for the unique event. The preliminary heats were run on Saturday the 25th inst. The sports will come off on the 1st. August. The Entertainment committee have on their programme four plays for the first night (30th) and one on the 31st. The Agricultural Officers of the iv. circle will enact a play dealing with Agricultural propaganda, written by Mr. S. Raja Ratnam.

* * * * *

The Gazetted Officers of the Department will meet in a special conference on the 30th and 31st at which a large number of important topics are to be discussed.

Correction. Mr. N. Sivaraj did not visit Coimbatore in connection with the selection of students as mentioned in our last issue. The members who visited were—Rao Sahib S. N. Ponnai Kavundar, Chairman of Coimbatore Municipality.

Mahboob Ali Baig Sahib Bahadur, M.L.C., Bezwada. The other member M.R.Ry. N. Ranganathan Avl., M.L.C. could not attend. We regret the error.

Association of Economic Biologists An Ordinary Meeting of the Association was held on Friday, the 24th July at 5-30 P. M. in the Freeman Building when the following two papers were read and discussed (1) Some physiological observations on Groundnut by U. Narasinga Rao, B. Sc. Ag., and (2) Cytological Studies in Cymbopogon Species by C. N. Babu, B. Sc.

Visitors. Dr. S. K. Sen, Physiological Chemist, Institute of Science, Bangalore visited the Institute during the month.

Weather Review (JUNE 1936).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	14·7	+8·9	28·9
	Berhampore *	11·3	+4·1	20·9
	Calingapatam	4·8	+0·1	11·1
	Vizagapatam	3 4	-1·5	12·4
	Anakapalli *	4·1	-0·9	18·4
	Samalkota*	8·8	+4·7	20·6
	Maruteru *	8·0	+5·5	15·0
	Cocanada	9·3	+4·5	17·6
	Masulipatam	3·3	-1·2	14·9
	Guntur*	2·9	-0·7	17·8
Ceded Dists.	Kurnool	3·8	+0·8	7·3
	Nandyal *	6·2	+1·6	8·6
	Hagari *	1·4	-0·2	5·8
	Bellary	0·9	-1·0	2·9
	Anantapur	1·3	—	5·1
	Rentachintala	2 6	—	6·4
	Cuddapah	3·4	+0·5	5·2
	Anantharajupet *	3·9	—	—
Carnatic	Nellore	0·9	-0·4	3·4
	Madras	2·8	+0·9	6·8
	Palur *	2·8	+0·9	8·7
	Tindivanam *	0·5	-1·7	6·8
	Cuddalore	1·3	-0·3	7·2
Central	Vellore	2·5	+0·1	6·4
	Salem	3·5	+0·5	15·9
	Coimbatore	1·5	-0·2	7·5
	Coimbatore Res. Inst. *	1·5	+0·1	7·3
	Trichinopoly	2 0	+0·6	8·8

Division	Station	Actual for month	Departure from normal @	Total since January 1st
South	Negapatam	1·6	+0·3	10·4
	Aduthurai *	1·2	-0·2	7·3
	Madura	0·8	-0·6	9·2
	Pamban	0·0	-0·1	5·4
	Koilpatti *	0·2	-0·3	8·8
	Palamkottah	0·7	+0·2	12·0
West Coast	Trivandrum	10·4	-3·0	33·0
	Cochin	18·9	-9·6	53·3
	Calicut	33·3	-0·8	59·9
	Pattambi *	23·1	+14·2	41·6
	Taliparamba *	33·3	·6·0	44·9
	Kasargode *	42·7	+4·5	58·4
	Nileshwar *	36·3	-5·0	48·2
	Mangalore	48·3	+11·5	59 9
Mysore and Coorg	Chitaldrug	3·8	+1·0	6·5
	Bangalore	2·6	-0·2	10·2
	Mysore	3·2	+0·3	15·5
	Mercara	40·5	+14·1	52·7
Hills.	Kodaikanal	5·7	+1·7	18·8
	Coonoor*	4·7	—	30·4
	Ootacamund *	9 7	+4·7	23·5
	Nanjanad *	11·7	+3·5	26·2

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Summary of General Weather Conditions. The monsoon was active almost throughout the month on the West Coast and in the North Madras Coast and was especially active in the West Coast at the end of this month.

Two depressions influenced the weather in the Circars during this month. The first depression formed in the north of the Bay on the 11th, and after developing into a storm crossed the Orissa Coast on the 12th--13th and moving in a W. Nw. direction filled up over West Central India on the 18th and caused heavy rains on the Orissa Ganjam Coast and along its line of traverse stimulated the monsoon on the West Coast and over the peninsula generally.

The second depression formed in the Bay between Chandbali and the Sandheads on the 26th passed inland near Chandbali on the 28th. This depression also gave heavy rain along the Orissa-Ganjam-Coast, and caused a strong monsoon on the West Coast and the Peninsula.

Rainfall was in very large excess locally in the Circars and in South Canara and Coorg and was nearly normal elsewhere.

Day temperatures were generally below normal in the areas of heavy rainfall.

Weather Report for the Research Institute Observatory :—

Report No. 6/36.

* Absolute Maximum in shade	92·0°F
* Absolute Minimum in shade	70·3°F
* Mean Maximum in shade	85·4°F
Departure from normal (of the month) ...	– 3·8°F
* Mean Minimum in shade	71·6°F
Departure from normal (of the month) ...	– 1·5°F
Total Rainfall for the month	1·46"
Departure from normal	+0·12
Heaviest fall in 24 Hours (Recorded on 29th.)...	0·52"
Total number of rainy days	4 Days.
Mean daily wind velocity	6·3 M. P. H.
* Mean Humidity at 8 hours	70·4 %
Departure from normal (of the month) ...	+ 1·1

* Temperatures were recorded only from 18th June.

The monsoon was fairly active during the month and rainfall was in slight excess. Day temperature was in large defect during the latter half of the month.

P. V. R. & D. V. K.

Departmental Notifications.

Leave. Mr. K. P. Anantanarayanan, Assistant in Entomology, l. a. p. for 2 months. Mr. C. A. S. Ramalingam Pillai, A. A. D., Manamadura, l a. p. for 6 weeks on M. C. Mr. N. Krishnaswami, Millet Assistant, leave out of India on half average pay for 28 months.

Postings and Transfers. Mr. K. Ambikacharan, A. D., Hindupur to iv Circle. Cuddalore Division. Mr. K. Guruswami Nayudu, F. M., Kalahasti is posted Livestock Research Station. Mr. T. Ramanugal Naidu, posted to Tenali for Dt, Work. A. Ramaswami Iyer, Offg. A. D. A., Madura posted to iv Circle for opening a new sub circle at Arkonam. Mr. P. N. Krishnaswami Rao, Assistant in Cotton, Guntur transferred to C. S. Section, Coimbatore. Mr. T. T. Devasighamony, F. M., on Probation Hagary to Dhone as A. D.

Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

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Editorial.

The Agricultural Graduate. Six decades ago, the first agricultural college in India, was started in Madras, and we recently celebrated the Diamond Jubilee of the event. Madras can justly feel proud of the progress, during this period, of agricultural education, a clear and interesting account of which as presented by the Director of Agriculture at the Conference, is published elsewhere. Sixty years constitute a considerable span in human affairs and in the process of evolution towards attaining the most satisfactory ideal, there have necessarily been considerable changes in the curricula of subjects taught in the college, in the courses and periods of training given, etc., and it is a matter for gratification that the products of the Madras Institute have played no mean part in the development of agricultural research and education in this province.

During this period changes have also been evidenced in the general outlook of agricultural education and the objects with which instructions were imparted in the College. In the words of the Royal Commission on Agriculture "It is plain that a most important function of the Colleges must be *to train the men required by the agricultural departments as without such men the departments must cease to exist*; but the agricultural student who goes back to his own land after passing

through the college course may be, *individually*, every whit as great an asset to his province as is the student who enters the public service. He has obtained the inestimable benefit of a general scientific training and the result should be to make his own land at once a demonstration centre of approved agricultural practice for the neighbourhood and, if he is of that turn of mind, an experimental centre also."

In the earlier years, with the impetus given to the expansion of the Government Agricultural Departments, both on the research and propaganda sides, by Lord Curzon, practically everyone who passed out of the college was absorbed into the Department, thus proving the Royal Commission's first statement. With the expansion of the department however becoming limited after a certain stage, a large number of graduates are without employment. While we might earnestly wish that these men fulfil in every measure the expectations of the Royal Commission by becoming "assets to their Province," it might not be quite legitimate to measure the success of the agricultural education imparted in the college by the number of men taking to private farming.

In the words of the Royal Commission again, it is the want of the correct mentality rather than the kind of instruction given in the college, that is responsible for graduates fighting shy of private agricultural enterprise. In addition to the mentality there is the inevitable feeling that the enterprise is risky because such complicated problems as availability of suitable land, general financial depression, unsatisfactory marketing conditions etc. induce a mood of hesitancy. We found during the discussions at the conference there were differences of opinion about the reliability of the statistics concerning cultivable waste lands available in the province. The scheme of colonisation with agricultural graduates adopted in Mysore has not proved, we are told, a success in spite of the help and impetus given to the scheme by the State. It is no wonder therefore that the prospect of unemployment is sometimes even more tempting than a risky speculation!

The example of the Punjab however, should merit some attention as the scheme of settling graduates on land has proved a success there within a short period. Here the graduates were each assigned 50 acres of land in a block in the newly opened canal areas with also other facilities such as loan of a small capital on easy terms etc. Here the large areas newly brought under irrigation with the development of irrigation projects, (cultivable waste lands in the real sense) have been made available for colonisation. In our own province new irrigation projects are afoot and we suggest that these will serve as better avenues for settling graduates on land than the so called cultivable waste lands about the suitability of which, for a commercial enterprise very little is known. It has often been mentioned that agricultural graduates not coming forward to take up the cultivation of the

Chintaladevi farm which was closed down in 1932 is an example of the lack of enterprise on their part. It is however, very doubtful whether this could in any way be compared to lands assigned in the Punjab or that might be available when the new irrigation projects are opened in Madras.

Here is an opportunity to test whether it is the mentality of the men or the availability of land with suitable facilities that has not induced graduates to take to private farming. If suitable areas under the new irrigation projects are thrown open for colonisation on moderate terms, we are sure, many of the unemployed graduates will rise equal to the occasion and prove themselves worthy of their *alma mater* and wipe off the stigma of inertia attributed to them.

Granting that the conditions for starting private enterprise are not very propitious at present, may we hope that Government will again examine the question of employing the agricultural graduates in other departments of Government which are directly or indirectly connected with the welfare of rural community such as the revenue, irrigation and co-operative departments. The Royal Commission which examined this question were afraid that if opening in other departments were held out as inducements to enter agricultural colleges, the best men from the college may not be available for the agricultural department. The question of unemployment among the agricultural graduates did not exist then and things have changed considerably since the Royal Commission reported. At the present time when every one, Government included, is actively thinking of schemes of rural reconstruction, this question of utilising the services of agricultural graduates who, by their very training are the most suitable for employment in rural uplift schemes, we feel, requires a more sympathetic consideration on the part of Government.

THE TWENTY-FIFTH COLLEGE DAY AND CONFERENCE

Diamond Jubilee Celebrations.

HIS EXCELLENCY'S VISIT

First Day. At 11-45 A.M. on Wednesday the 29th July, His Excellency the Governor of Madras, Sir K. V Reddy Naidu accompanied by his personal staff arrived at the institute, and was received by the Minister for Public Works, the Director of Agriculture, the Principal, and the Secretary of the Union. The students of the College, presented a guard of honour. The members of the Managing Committee and the Gazetted officers of the Department were then presented to His Excellency. In the Conference Hall a distinguished gathering of non-officials and officials was present. Among those present were Rao Bahadur A. T. Pannirselvam, Home Member, Rao Bahadur C. J. Paul, Development Secretary, Dewan Bahadur C. S. Ratnasabapathy Mudaliar, Dewan Bahadur T. A. Ramalingam Chettiar, Mr. B. G. Holdsworth, Mr. V. C. Palaniswami Gounder, the Pattayagar of Palayakottai, and the Rajah of Kollengode. On His Excellency assuming his seat on the dais, the Principal moved a resolution congratulating His Majesty the King on his recent escape from danger. Mr. R. W. Littlewood then delivered his welcome address after which the Secretary garlanded His Excellency. Messages from the Viceroy and others were then read by the Secretary. Rao Bahadur D. Ananda Rao, made a speech giving an account of the progress of Agricultural Education in Madras. The Secretary read the report of the Managing Committee. His Excellency then delivered his speech, in the course of which, he reviewed the main activities of the Department, for the last 20 years, and dwelt on the benefits which have accrued to the people of this province thereby. He finished his excellent speech by exhorting his countrymen to put their shoulders to the wheel and do all they can in furthering the splendid aspiration and effort of the noble Viceroy who is determined to help India to the utmost possible extent. His Excellency then distributed the prizes to the various winners. The Director of Agriculture proposed a hearty vote of thanks to His Excellency and the proceedings came to a close.

At 1-30 P. M. Rao Bahadur D. Ananda Rao, gave a luncheon party in honour of His Excellency to which about 40 distinguished guests were invited. At 3-45 His Excellency accorded an interview to the Director of Agriculture, the Principal and the representatives of the estate residents in connection with the supply of Siruwani Water to the College Estate. At 4. P. M. His Excellency went round the exhibition, and was pleased with the effort of the Department. At 4-30 P. M.

His Excellency took tea with the Gazetted Officers of the Department, and left for Ooty at 5-30 P. M.

Second day. The Proceedings began with the unveiling of the potrait of Mr. Wood, by Rao Bahadur D. Ananda Rao. Mr. K. Ramiah in requesting Mr. Ananda Rao to unveil the portrait made a brief speech and gave an account of the Memorial fund. Mr. Ananda Rao in unveiling the portrait referred to the outstanding traits exemplified in Mr. Wood's chaıacter, and after a short speech unveiled the portrait amidst cheers.

The Hon. Minister for Public Works, Mr. P. T. Rajan then inaugurated the conference after a few remarks.

The following papers were then read.

1.	Our Viceroy and Agriculture.	By Rao Bahadur. K. S. Venkatarama Iyer.
2.	Improvement of Cattle.	,, R. Cecil Wood.
3.	Inheritance Studies in *Saccharum*.	,, Dr. E. K. Janaki Ammal.
4.	Agricultural Propaganda.	,, Rao Sahib N. S. Kulandaiswami Pillai.
5.	Studies on the effect of Arrowing in canes under Coimbatore conditions.	,, K. Krishnamurthi Rao.
6.	Sorghum for Popping.	,, Rao Bahadur G. N. Rangaswami Iyengar and M. A. Sankara Iyer.
7.	Research and Propaganda work in Bee-keeping.	,, M. C. Cherian and S. Ramachandran.

The session closed at 11-15 A. M.

Third day. The following papers were presented on Friday the 31st July with the Hon. Mr. P. T. Rajan in the chair.

8	Village guidance in the New Era.	By N. Lakshmanan.
9	Cultural methods of controlling plant diseases.	,, Rudolph D. Anstead,
10.	Soil conditions as affected by cropping in the black soil area of the Tinnevelly District.	,, Dr. S. Kasinathan and M. R. Balakrishnan.
11.	Some Experiences of the performance of Sorghum strains evolved at the Agricultural Research Station, Nandyal.	,, P. Subrahmaniam.
12.	The present position of Nandyal 14 in the northern area.	,, L. Neelakantan.
13.	Preliminary studies in Plantain.	,, M. Narasimham.
14.	Fruit sucking Moths on Tomato and their control.	,, M C. Cherian and C. V. Sundaram

The Minister then delivered his address.

The Principal propsed a vote of thanks and the Conference came to a close.

Fourth day. The annual general body meeting was held, at 8-15 A.M. with the Principal in the chair. In the evening the College Day Sports

were held, and the Union was at home to members and visitors. Mrs. R. W. Littlewood kindly gave away the Prizes to the winners.

The celebrations were on the whole a grand success.

Entertainment. On Thursday the students of the college put on boards, four dramas, in Telugu, English, Malayalam and Tamil, which were highly appreciated, by the audience. The Hon. Minister for Public works, graced the occasion by his presence.

On Friday, the Demonstrators of VI Circle staged *Vivasayakandam* a drama written by Mr. C. S. Rajaratna Mudaliar, Mycology Demonstrator. The drama was the prize winning effort of the author, written in connection with the competition instituted by the Department for the best drama dealing with Agricultural Propaganda. The play and songs were very appropriate and the author and the actors, deserve our congratulations.

The Principal's Welcome Speech.

MR. R. W. LITTLEWOOD, *Principal.*

Your Excellency, Ladies & Gentlemen,

In opening my address I must explain that I can only claim a very few weeks' intimate acquaintance with the work in the College and the activities of the Madras Agricultural Students' Union of which I am the ex-officio President. In the ordinary course Mr. R. C. Broadfoot should have enjoyed this privilege and we all miss his presence here to-day.

It is just over a decade and a half since Your Excellency first came into official contact with our Department as its First Minister, appointed from the elected members of the First Provincial Legislative Council. We recall with pleasure your efforts on behalf of Agriculture and Agricultural development in your official capacity then and the older members of this department, I am sure, must still remember with pleasure the various occasions on which they came into contact with you and had the benefit of your sympathetic guidance and help. In 1923 you presided over our deliberations and the encouraging words which you then uttered about the work of the various sections of this department are still remembered. This Union has been following your activities in and out of India with great interest and pride and it is with the greatest pleasure that we now welcome you once again to this College in your present capacity as Governor of this Presidency.

To our present Minister who, although he prefers to be known officially as the Minister for Public Works our welcome is certainly none the less sincere. To the Development Secretary Rao Bahadur C. J. Paul, to our Director of Agriculture Rao Bahadur D. Ananda Rao and to all of you Ladies and Gentlemen who have accepted our invitation I, on behalf of the Union, as well as on my own behalf. extend a cordial welcome. This is a special occasion in that we celebrate this year the Diamond Jubilee of Agricultural Education and the Silver Jubilee of the Students' Union.

By this time next year it is expected that full Provincial Autonomy will have been introduced into this Presidency. How and in what directions it will affect us, it is difficult to say now. But I, as one who has spent all his official career under the transferred half can assure Your Excellency that for the advancement of Agricultural Education and the well-being of the cultivating classes, the members of this Union will extend the same willing and loyal co-operation to the Government of the future as they have done in the past.

Rural reconstruction and village uplift are receiving much greater attention to-day from all quarters both official and non-official and there is no better equipped set of men for this work than the graduates of this College. I hope that Your Excellency may keep this in mind and be pleased to utilise the material available whenever opportunities arise.

I find from the records of the Union that there are still many officers and a large number of them, ex-students of this College who have either not joined the Union or have discontinued their membership. I request you all to remember that during the last 25 years it is mostly due to this organisation that it has been made possible for us to come together annually to take part in these functions. I request all these officers to join the Union at once and to give it their full support.

We are fortunate in having a Viceroy who is a Practical Agriculturist. He has set a very good example for others to follow in purchasing and maintaining three breeding bulls for the use of the ryots to improve their cattle. It is to be hoped that many Zamindars and large land owners in this Presidency will follow his example. Breeding bulls alone will not fulfil this, it is essential that the young stock born to these bulls should be well fed and maintained from birth onwards. The female stock produces all our work cattle and milk and it is imperative to see that they are well fed and maintained. The high position of English Livestock to-day is largely due to the efforts and example of our noblemen and landed gentry in the past. These gentlemen devoted a large amount of their time and money to the development of Agriculture and the improvement of Livestock on their home farms and among the tenants in their estates.

I would like here to congratulate the members of the Coimbatore District Board and especially their President The Hon'ble Mr. V. C. Vellingiri Gounder on their efforts in the improvement of Livestock in this District. There are over 60 premium bulls in the District of which the District Board owns about 40 and proposals to place five Scindi and five Delhi Buffalo Bulls to improve the milking qualities of the cows and buffaloes in towns and villages have also been accepted by the District Board this month.

It is to be hoped that Government will see their way to open more cattle breeding stations in the near future so as to improve the various breeds of cattle and buffaloes in the Presidency, especially the Ongole breed, and to distribute more pedigree stock to the villagers.

The Secretary will shortly place before you a detailed report on the working of the Union for the last twelve months.

My colleagues and I trust that your visit here will be useful as well as pleasurable and that you will carry away with you pleasant memories of our Jubilee Celebrations.

Agricultural Education in Madras.

BY RAO BAHADUR D. ANANDA RAO,

Director of Agriculture.

Your Excellency, Ladies and Gentlemen,

In response to the request of the Working Committee of the Madras Agricultural Students' Union, I have undertaken on this important and unique occasion—the sixtieth year anniversary of the Agricultural Education in this Presidency—to present to you, Sir, a brief account of the past. Ten years ago when the Golden Jubilee was celebrated those who were present on the occasion would have listened to a very succinct account of the history of agriculture in

India traced from a time even prior to the British days. It is therefore, sufficient if I but briefly recall to your minds only the salient points in its history.

Let me for a moment ask you to imagine with me a piece of land entirely sandy in nature infested with prickly pear—free at that time from the molestations of the Cochineal insect—destined to be the site of a Government model farm because it was the only land belonging to Government available in the vicinity of Madras. History tells us that the Superintendent of the farm was a good gardener but with a very superficial knowledge of farming and was assisted by an overseer with no knowledge of farming whatever, one who could neither read nor write but a steady and trustworthy man all the same! Here were laid sixty years ago the foundations for a College of Agriculture—though in the beginning it was only a school located in a granary—for the improvement of agriculture of this Presidency and as in many other things, Madras led the way in being the first in the field in possessing at Saidapet the only College of its kind in all India. The object of that college was chiefly to create a class of men who would go back to the land and carry out the methods of farming on modern lines which was sought to be attained by conducting experiments—varietal, cultural, manurial, and irrigational and by the introduction of new and improved implements and by improving the live stock of the country by conducting experiments in breeding.

The College at Saidapet had a chequered career; it was transferred from the Board of Revenue to the Educational Department, the courses of instructions varied at frequent intervals, candidates were prepared for technical examinations and examined by men who had no knowledge of what was taught at the College or what was required of Agricultural students.

The reorganization of the Agricultural Departments in India in 1904 under the influence of Lord Curzon meant a drastic change in policy. It laid emphasis on the interdependence of research, education and demonstration in the scheme laid out for the amelioration of the condition of the ryot. It at once meant a change in staff, buildings and surroundings as the farm and small laboratories at Saidapet were quite unsuited and inadequate to meet the new requirements of Scientific experts. The curtain was therefore dropped on the scene of activities at Saidapet in 1907 after a course of 31 years and when it was raised again in June 1908 at Coimbatore, we found ourselves established on a broader and more secure foundation.

At Saidapet, it should be mentioned the students were recruited largely from the clerical ranks of the Revenue Department in the hope that these revenue officers after training in the practice and theory of agriculture would diffuse the agricultural knowledge amongst the ryot population. The result was that several students

were too old to profit themselves by the training nor did they go back to land but only as officers of the Revenue department. In spite of the limitations that Saidapet suffered from, there is no denying the fact that it has produced some excellent men who have been the mainstay of the activities of the reorganised department of agriculture. In fact, we have before us men who, faced with new situations rose to the occasion and served the new College loyally, faithfully and efficiently and are enjoying their well-earned physical relaxation. The foundation stone of the new College at Coimbatore was laid by His Excellency Sir Arthur Lawley who declared that the object of the College was the culture of the land and culture of the people who work the land. Since its inception even this college has had its vissicitudes. The single course of 3 years leading to Diploma was dropped in 1914 as it was considered advisable to have two courses—one a thoroughly practical course lasting 2 years known as the Certificate of Proficiency, and another—an extension course of 18 months—called the Diploma course—to a picked few from the successful ones of the short course at the end of which a diploma was awarded. Further changes took place later as a result of the recommendations of a special Committee appointed by Government in 1920 which stated that as the Certificate Course was not popular, the standard of education should be raised in order to attract suitable type of students, and to do so, the College should be affiliated to the University. The Diploma course was, consequently abolished in 1922 and the Certificate Course came to an end in 1925.

The College was affiliated to the University of Madras with effect from the academic year 1920—21 synchronizing with Montford reforms, when you, Sir, were our First Minister for Development. The interest and sympathy you evinced in the welfare of the department during those early years of your connection with us are still green in the memory of those who had the good fortune to come in contact with you.

Intermediate in Science was fixed as the minimum qualification for admission into the College and the first batch of B. Sc. Ags. came out successful in 1923. Several scholarships were awarded in the beginning to attract good students but as the number seeking admission increased, these were restricted to a few.

With the opening of the Freeman Building in 1926 which synchronised with the Golden Jubilee celebrations of Agricultural Education, the number of admissions was raised from 20 to 48 in view of the greater facilities for laboratory and class room accomodation. Free tuition was given till 1932 when the axe of retrenchment rendered it necessary to discover fresh avenues for revenue with the result that students now pay Rs. 120 a year while those belonging to the Native States Rs. 1200 per annum.

The number of graduates that has passed out of the College up-to-date is 344 out of whom 130 are reported to be without employment. As stated already, when the object of the College is to train men to become scientific agriculturists one might well ask why a reference is made to the large number of unemployed graduates. We must, however, face facts. On the one hand, in a poor agricultural country like ours where cultivation is largely in the hands of people who, though experts in their art, have not the wherewithal to spend on permanent and major improvements and who are hard put to it to eke out something by the sweat of their brow, the majority of whom have not yet been influenced by the department to such an extent that it could be said that their general economic condition has been raised and on the other in a country where the educated well-to-do classes have no interest in the land except as a safe investment for their savings and from which class most of our students are drawn, it is perhaps to be expected that the majority of students passing out of the College look forward to appointments in Government or other service.

There is another aspect to this question. The budding lawyer considers it essential to apprentice under a senior before he could stand on his own legs. Similarly, though the agricultural graduate knows the correct methods of farming, he has not when graduating the detailed knowledge of the business side of farming which can be obtained only by experience. He therefore prefers to learn it at the cost of Government. When once he enters service he is caught by its glamours and is loathe to enter the adventurous field of farming. It is therefore in the hands of the agricultural graduates themselves to remedy the defect. How many of the past students of the College who have lands have attempted to undergo training in Government farms or on estates of private gentlemen as honorary workers? I may sound a note of warning. Although there is yet room for the department to expand, there is a limit to it and as years go by and as more graduates become available the country would need more and more experts in modern methods of farming. A time will come when our landed aristocracy and other landowners will take more direct interest in their lands, and would need the assistance of trained men in Agriculture. When there is a demand for such, the department should be in a position to say that not only are there a large number of agricultural graduates available but also men who have gained experience in managing large farms, private or Government. The department will only be too willing to give a helping hand to such as are anxious to supplement their practical training at the College in the way indicated.

Let me now pass on to another aspect of agricultural education. Though it was confined to this one college till 1918 it was felt that there was a need in the districts for schools for sons of labourers

employed in the Agricultural stations in the Presidency. There are only three such schools at Anakapalle, Palur and Coimbatore and one under the control of the District Board at Usilampatti originally intended for Kallar boys. Besides, agricultural middle schools were started in 1922, at Anakapalle and Taliparamba for the sons of landlords but as it was soon found that there was no demand for them they were closed in 1927 and 1932 respectively. Agricultural instruction has also been sought to be imparted in a few schools under the management of missionary bodies but nothing outstanding has been the outcome of these schools so far.

In these days when so much is talked of rural reconstruction it is indeed strange that there are hardly half a dozen schools imparting instruction in agriculture in this Presidency though agriculture has for over 30 years formed a separate subject for examination under the Government Technical Examination scheme and though it has formed an optional subject for the S. S. L. C. examination and has been rcognised by the Madras University also as an optional subject for the Intermediate Examination.

However the Government through the suggestion of the Department took another step forward to popularise agricultural education in starting short courses to serve the needs of the sons of well-to-do landowners who are likely to take more than ordinary interest in their lands. They however differ from the old short courses started in 1914 in that the courses are all limited to the cultivation season of the year and that they do not lead to any examination. These were started in 1933 and include courses in Bee-keeping, Dairying, care of animals, malt-making etc,, varying in duration from 2 weeks to 9 months. These courses have so far cost Government very little and are reported to be popular judged from the number of applications received but it is too early to pronounce a definite opinion on them. This year the farm management course has been extended to Nandyal and Taliparamba Agricultural Stations as it is felt that Coimbatore cannot cater to the needs of the whole Presidency. It is hoped that if these courses become popular each district possessing an Agricultural station should be able to run similar courses.

So far for the history of agricultural education in this Presidency and the different directions along which attempts are being made to spread it among the masses. Sixty years are but a short period in the history of a nation. and though the achievements are not great, the future is hopeful. This is not the time for despondency. We are in the fortunate position of having a Viceroy who has promised to do all he can to help the lot of the ryot. That he is a gentleman of action is evident from the practical steps he has already taken. There is little doubt that during his tenure of office he would lay the broad foundations for the material prosperity of this Agricultural country

of ours. But in an important matter such as this, to achieve much it cannot rest entirely with one but all those who have the requisite facilities and opportunities should help the cause. I therefore request you, Sir, coming as you do from the farming class, to exert your influence in making the landed aristocracy take a practical interest in the cattle and lands they possess and endeavour their best to improve them.

The Report of the Managing Committee.

Your Excellency, Ladies & Gentlemen,

The Committee beg to express their sense of deep gratitude to His Excellency Sir K. V. Reddy Naidu Garu for graciously consenting to be in their midst to-day, on this most happy occasion when the Union celebrates the Twenty-fifth year of its existence along with the *Diamond Jubilee* of Agricultural Education in India. The Principal and the Director, have in their speeches referred to the great services rendered by His Excellency to the cause of the agriculturist while he was Minister for Development. The Union most heartily endorses their statements and takes this opportunity to tender its respectful congratulations on his appointment as the Governor of the Madras Presidency. For the Union it is a matter of no small amount of gratification, that one who has been closely associated with Agriculture by tradition and office has been exalted to the highest eminence in the Province. It recalls with pleasure the words uttered by him as President of the Conference in 1923 to the effect that whether as a Minister or member, Agriculture would always be dear to his heart, as he believed that its development was one of the best means of bringing about the uplift of the country. True to his word he has given us a proof of his abiding interest in Agriculture by his presence to-day.

The Minister. To the Minister for Public Works the Honourable Mr. P. T. Rajan whom we venture to claim as one of us, the Committee tender their grateful thanks, not only for consenting to preside over this year's Conference but also for the great interest he has been evincing in the affairs of the Union all these years.

The Madras Agricultural Students' Union. It is appropriate on an occasion like this to give an account of the birth and growth of the Union and recall with gratitude the labours of the early founders of this institution whose devoted attention in laying its solid foundations has enabled successive committees to build the superstructure of which we are rightly proud.

The Union, as such, was founded in the year 1911 when the First Conference under its auspices was held under the distinguished Presidentship of Mr. M. A. Couchman, I. C. S., the first Director of Agriculture of this Province; though an association of Agricultural Students was in existence as early as 1885 at Saidapet, the Union was organised as the result of a resolution passed at an informal meeting on 14th July 1910 and was primarily intended as an organisation to bring together in a common bond of interest the past students of the Saidapet Institution and the students of the Coimbatore Agricultural College. The objects of the Union, as set down in the memorandum were as follows:—

1. To create an *espirit de corps* among its members.

2. To exchange opinions and experiences in matters agricultural and to make a record of the same,

3. To act as far as possible as a bureau for procuring employment of the members of the Union and the objects were sought to be attained by the annual

celebration of the College Day and Conference, the conducting of a Journal and the maintenance of a corrected list of addresses of all the past students.

The credit for founding this institution and nurturing it in its infancy is largely due to the labours of Mr. R. C. Wood and his associates, prominent among whom were Mr. (Rao Bahadur) M. R. Ramaswami Sivan, Mr. (Rao Bahadur) C. Tadulingam, Mr. K. Krishnamurti Rao, the late Mr. D'Silva, the late brothers Rao Bahadur Selvaranga Raju and Dharmaranga Raju and our present Director who joined this band a little later.

Since that time, the Union has had to pass through much difficult times but thanks to the sustained efforts of successive committees it has been able to widen its scope of usefulness, and stand to-day in its adolescence, proud of itself as an organisation which serves not merely as an old boys' association, but as a link between the Department and the public. A brief review of the activities of the Union during these 25 years will not be out of place.

The Union Building. To begin with, the Union had no building of its own. Through the kindness of Mr. Wood, the then Principal, two rooms were placed at its disposal in the College Hostel till the year 1924 when with the aid of contributions from members and patrons, and a grant of Rs. 671 from Government, a small building was constructed in which the Union is now housed.

Conferences. The Union has so far organised 24 annual College Day and Conferences. The Union has always been fortunate in the choice of its Presidents of the Conference and many distinguished officials and non-officials have adorned the Presidential Chair. It has had the privilege of inviting His Excellency Lord Pentland, and His Excellency Lord Goschen while they were Governors to preside over the annual conference in the years 1918 and 1928 respectively.

In these annual Conferences, besides the officers of the Department, a few of the leading non-officials of the Presidency, like the Honourable Mr. Vellingiri Gounder and Rao Bahadur K. S. Venkatrama Ayyar, always took a prominent part, and we would take this opportunity to urge all those who are interested in the progress of Agriculture, to come and attend our Conference, and help us with their suggestions and criticisms.

The Journal. Besides the holding of the annual College Day and Conference, the most important activity of the Union has been the conducting of the Journal. The Journal was first published as a Year Book in 1911, and then as a quarterly till the year 1915 when it was converted into a monthly. The publication of a regular monthly was no easy task. The financial resources of the Union, dependent almost entirely on the voluntary contributions of its members, were strictly limited. And added to this was the absence of a good printing press at Coimbatore. But in spite of all these handicaps the Journal sustained by the enthusiasm of those responsible for its production, managed to hold its own, and after a hard period of struggle has been able to reach a stage when it is more or less able to maintain itself, and its regular publication is no longer a cause of anxiety to the Editorial Board.

The Madras Agricultural Journal, the committee are glad to state, is now recognised all over the world, as an important agricultural publication. It has among its subscribers many Zamindars and other enlightened landowners of the Presidency and the Committee have no doubt the Journal has a great future before it.

1935—36. Coming now to the activities of the Union during the year 1935—36, the Committee, have firstly, to record the melancholy event of the passing away of His Majesty King George V. His death cast a gloom over the entire world and the Union shared with millions of His late Majesty's subjects the great

sorrow, and sent a humble message of condolence to the members of the Royal Family. A meeting of the residents of the College Estate was organised by the Union and other associations, and a resolution expressing our heart-felt sorrow at the demise of the late king, and another expressing our loyalty and allegiance to King Edward VIII were passed.

His Excellency Lord Linlithgow. The Union in its last report expressed the hope that the new Constitution would be worked in the interest of the tiller of the soil who forms the backbone of the country. As if in response to its wish, the appointment of Lord Linlithgow came as a welcome surprise to the members of the Union, whose hearts were gladdened that in the New Viceroy at any rate the poor agriculturist would find a sincere friend and well wisher and one who will safeguard his interests. His Excellency, as President of the Royal Commission, has acquired an intimate knowledge of agricultural conditions in India, and what is more important, with deep insight has understood the psychology of the Indian cultivator, as that excellent little brochure of his 'The Indian Peasant' will show. His Excellency has by his munificent acts set an example, which we are sure, will be emulated by all the leading men of this country in putting the welfare of the agriculturist foremost in their thoughts. The subject of cattle improvement on which His Excellency has set his heart, has at his instance received an impetus, and the Union hopes, that before long his cherished desires will become accomplished facts.

Diamond Jubilee of Agricultural Education. The Union was responsible for the celebration of the Golden Jubilee of Agricultural Education in the year 1926 and encouraged by the fact that the Government helped it with a grant of Rs. 1500 at the time, ventured to draw up an ambitious programme for celebrating the Diamond Jubilee this year in the hope that a similar grant will be forthcoming, but owing to the inability of the Government to come to its aid the Committee had to curtail its original programme to a considerable extent and alter it to suit its financial capacity.

Meetings Two meetings were held during the year under the auspices of the Union:—

1. Paddy cultivation in Bengal by Mr. K. Banerji, Rice Research Officer, Bengal.
2. Agriculture in Burma by Mr. K. Ramiah, Paddy Specialist, Madras.

The meetings were well attended.

The Journal. The Committee are glad that the Journal was published regularly during the year maintaining the high standard set up in previous years. The Journal has 800 subscribers of whom nearly 200 are non-officials. If all the members of the agricultural Department subscribe to the Journal the Journal will have on its rolls nearly 1000 subscribers, and it will be possible to effect considerable improvement in its present get up. The Committee takes this opportunity to appeal to all those who have hitherto kept aloof to join the Union and thus augment its resources. The Committee would also respectfully request the Government to render a little financial aid which will help us to increase the usefulness of the Journal.

Last Year's Conference. The Twenty-fourth College Day and Conference was held on Friday the 2nd August 1935 under the distinguished Presidentship of the Revenue Member, the Honourable Mr. (Sir) C. A. Souter. The President in his address laid stress on the need for closer contact between the officers of the Revenue and Agricultural Departments. An account of the last College Day and Conference has already been published in our Journal.

Our friends abroad. Three of our members have gone abroad for further studies. They are Mr. K. M. Thomas, Mr. Kochukrishna Pillai and Mr. S. Ramanujam.

The Union wishes them every success. The Union is glad that Mr. C. Ramaswami, Assistant Director of Agriculture, has been chosen as one of the players in the All India Cricket Team visiting England. We wish him good luck.

M. Sc., Degree. Mr. T. Varahalu was awarded the Degree of M. Sc of the Madras University for his thesis on the Chemistry of Jaggery making.

Retirement. During the year under report, Mr. F. H. Butcher and Mr. T. Lakshmana Rao retired from service. In their retirement the Department loses the services of two experienced and able officers.

Titles. To Rao Bahadur Mr. S. Sundararaman our Vice-President. Rao Bahadur Y. Ramachandra Rao and Rao Sahib C. Narayana Ayyar, Mr. F. H. Butcher, O. B. E the Union tenders its congratulations on the titles conferred on them by the Government in recognition of their services to the Department.

Obituary. The Union sustained a heavy loss during the year in the deaths of Mr. M. Rajagopala Ayyar one of its active members, Sir M. Ramachandra Rao one of its former Presidents and a sincere well wisher of the Agricultural Union, Sir Frederick Nicholson who till his last day was in intimate touch with the Union and Student Dharmarajan, and our heart-felt sympathy go to the bereaved relatives.

Acknowledgments. It is now our pleasant duty to record our thanks to all those who have helped the Union during the year. To Sir Charles Souter the Union owes a debt of gratitude for presiding over the last year's Conference and to Mrs. B. G. Holdsworth our thanks are due for distributing the prizes on the sports day. To Mr. R. C. Broadfoot and Mr. Littlewood who as ex-officio Presidents have identified themselves with the Union, the Managing Committee offers its heart-felt thanks for guiding the affairs of the Union during the year. To Rao Bahadur D. Ananda Rao, the Director, the Committee tenders its grateful thanks for his sympathy and invaluable help rendered in the arranging for the celebrations of the Jubilee. To Mrs. Cherian, Mrs. Charley and Mrs. Raghavan and all those ladies and gentlemen who helped to make the last Conference a success and helped the Committee during the year in many ways, our thanks are herein recorded.

Conclusion. This brings us to the close of our report but before we conclude, the Managing Committee have one more duty to perform and that is to bring to the notice of the public and the Government that a large number of Agricultural Graduates are without employment. The Union has time and again reiterated that the talents of these young men should not be allowed to run to waste. It is a pity, that in a country where almost the entire population is dependent on Agriculture, and at a time when the whole atmosphere, so to speak, is surcharged with enthusiasm for agricultural improvements, the services of these trained men are not harnessed by the State and the people.

His Excellency's Speech.

"Let me thank the organisers for the opportunity they have given me to be here once more in your midst. I say once more, because, as has been told you just now by almost all the speakers that have preceded me, this is not the first time that I come to this place nor am I a stranger to you all. In their generosity, they have been pleased to say very kind things of me for the little assistance that I gave for the humble efforts I made as the first Minister of Agriculture in this province. True, it was my privilege and I may assure you that

I am still proud, legitimately proud, pardonably proud of being the first Agricultural Minister in this province. As you have been told a little while ago in quoting one of my own speeches, I belong to the agricultural community. *Kappu* is my caste. It means an agriculturist. Let me be a Member of Government or occupy some higher place, I shall never be ashamed of being called a farmer or a farmer's son.

Personal Reminiscences. " And now let me turn to the diamond jubilee of agricultural education in this province and the silver jubilee of the Union and congratulate you on attaining this age. You have just now listened to a very excellent account of agricultural education in this province, how from a little school in a granary of a model farm, so called by courtesy, because it was not much more than prickly pear and the sands to which reference has been made, from that state it has developed into this magnificent building in which so many bright and brilliant faces are seen, learning their lessons in agriculture with the object of benefiting what has been called the backbone of the nation. And then the Union's history has been given. But before I refer to the Union, let me refer to one or two personal reminiscences of friends who have come from this very humble school in the midst of prickly pear and sands. Opposite to me sits my old friend, Mr. Sivan, who has come from this very prickly-pear college and yet has risen to occupy the Principal's place in this magnificent building. So did my friend Mr. C. Tadulingam whose absence here we are all very sorry for. As for the Union, you have listened to the excellent work which they have done during all these years. And the journal has been publishing the results of their researches in the College and on the farm of which I should think anybody could be legitimately proud."

" In congratulating you on the progress which you have made, I think it would be of considerable interest, if I were to mention briefly some concrete examples of what the Government has done for the Agricultural Department and of what the Department has done for the agriculturist during the period that has elapsed since the introduction of the Montague-Chelmsford Reforms.

" Figures make uninteresting reading and I will not burden you with them more than I must, but I may point to an increase in the personnel of the Department excluding the Director and his office from 337 in 1921 to 916 this year and in its cost, from under 5 lakhs in 1921 to over 10 lakhs in 1936. Whereas in 1921 we had 164 Farm Managers, Assistant Managers, Agricultural Demonstrators and Assistant Agricultural Demonstrators costing Rs. 1,51,313 we have at present 290 of them, costing Rs. 4,05,796. In 1921 the proportion which the total expenditure on the Agricultural Department bore to the total expenditure of this Province was one rupee in 118. Last year, it rose to one

rupee in 89. Add to this, that since 1921 no fewer than ten new Research Stations have been opened in various parts of the Presidency and I think you will agree that the Government has shown a convincing interest in the progress of the Department.

The Achievements of the Department. " Turning now to what the Department has achieved for the benefit of the agriculturist, I would remark that the aim and object of the Department in general has been to secure increased crop returns, increased fertility of soil and better quality of crop output, both for domestic consumption and for market. To this end, we have our specialists who carry out research into the improvement of specific crops such as paddy, cotton, millet and oil seeds and our other specialists who investigate the cause and cure of crop pests and diseases and delve into the mysteries of the biological, bacteriological and chemical analysis of the plant and the soil and in every branch of its activity, the Department can point with pride to the solid achievements for the benefit of the ryot. Take for example paddy, our most important crop. Here the Department has evolved new strains giving increased yield of from 8 to 25 per cent and has introduced economic methods of planting and improved manurial treatment. In 1921, the total acreage under these various improvements was under seven lakhs. To-day it has risen to nearly twenty-seven lakhs and the gain to ryots resulting directly from these improvements which was in 1921 estimated at some 26 lakhs of rupees is now estimated at nearly a crore and a quarter of rupees. Or again, take sugarcane, the most profitable crop and one that has benefited by research work perhaps more than any other. In 1921 the total area under various improvements recommended by the Department was less than 8,000 acres, to-day it is nearly 90,000 acres which represents almost the whole of normal acreage of land under this crop and the estimated gain to the ryot has risen from something over five lakhs of rupees to as much as 24 lakhs. It is true that the imposition of import duty on foreign sugar is to some extent responsible to this large increase but the influence of the results of research work of the officers of this Department cannot be over-estimated. May I in this connection take the opportunity of congratulating my old friend, Mr. Venkataraman on the splendid work he has been doing.

Gentlemen, I could quote similar figures for our other crops but if I did so, I would weary you. Here in Coimbatore your chief interest is in cotton and you are all familiar with the improved Cambodia strain, which the Department has evolved which gives a clear increase of 15 per cent yield over the bazaar strain. Or, I could mention groundnut whose yield has been increased by as much as 20 per cent or millets, the poor man's food-crops, which are the subject of intensive research into their special peculiarities.

Improvement of Live-stock. "Finally, I would come to the subject of cattle-breeding. For nearly 20 years now, the Madras Government have maintained cattle farms with the object of building up pedigree herds of the best types of cattle with a view to improving cattle throughout the country by means of stock of good stud bulls. Progress has been slow but something has been achieved. Though our experiment with Ayreshire bulls has unfortunately not been a great success, other and local kinds of stud bulls are maintained at the Agricultural Farms, at the Veterinary College, Madras, and at veterinary hospitals in the districts. Grants are given by Government towards the cost of maintenance of good breeding bulls. Bulls are loaned by the Department to local bodies and co-operative societies and here in Coimbatore as I was saying the other day, we have a model scheme, whereby with the help of a grant from the Government, stud bulls are purchased by the District Board and supplied to approved ryots and institutions every year. The number of bulls so purchased annually has risen from one in 1921 to one hundred in 1935. It will be seen from this statement of our progress, that we have been able to do something in the interests of agriculture and the agriculturist.

A Great Opportunity. "But it is equally clear that it is not enough. We have just touched the fringe and there is a vast deal more indeed to be achieved. It is a Himalayan task and Everest has yet to be conquered. Fortunately, however, for us, ready to inspire us, we have an intrepid leader. The destinies of this country are now in the hands of a Viceroy who is not only thoroughly acquainted with the condition of our agriculturists and their industry but has shown so deep and abiding an interest in their material welfare in their crops, in their cattle, in their stud bulls and milch cows and in the health of their children, that it may confidently be asserted that the future of the agriculturist is assured. His Excellency has started a campaign and has given it such momentum that it is bound to have far-reaching results in benefiting the farmer to an extent, never attempted before. It is a great drive that he has undertaken, it is a nation-wide drive. It affects 80 per cent of the population of this great country. It means material prosperity of almost the entire people ; it means increased production, more national wealth, more food and more milk, healthy children and so healthy men.

"My Government and I are determined to play our part in this great campaign. We are ready to give it our unstinted support and wholehearted co-operation." In that memorable address, which His Excellency the Viceroy recently delivered before the Imperial Council of Agricultural Research Institute, he gave us the watchword, "the road is clear, full steam ahead." It is for us to seize the advantage and to take our place in the race. And let not the Madras Presidency fall behind other provinces in the running of it.

Appeal to Countrymen. I most urgently impress upon those who are present here and upon all whom my words may reach, that here is an opportunity, which, taken at its ebb, will lead us on to great things, to the increase of material prosperity of our countrymen, to a better standard of living, to a fuller life and to greater happiness and joy in the homes of those that form the backbone of our nation. I appeal to all our countrymen to put their shoulder to the wheel and do all they can in furthering this splendid aspiration and effort of a noble soul who is determined to help India to the utmost possible extent. (*Loud and prolonged applause.*)

Minister's Opening Speech.

The Hon. Mr. P. T. Rajan, in inaugurating the proceedings, thanked the organisers of the function for the honour done to him. He said he was no stranger to this institution because two of his uncles had been the alumni of this institution and he was glad that connection with the College had continued in his presiding over the Department which was intimately connected with their institution. Almost the first thing he did as Minister was to consider the idea of introducing a short course in agriculture so as to prepare the students belonging to families of agriculturists and give them a training which would enable them to make the land yield more. He believed that that short course had become popular. What the results were it was too early perhaps to say. Nevertheless, he hoped that as time went on, students would take advantage of it more and more.

Minister's Concluding Speech.

Ladies & Gentlemen:

Now that we have come to the end of our labours, I wish to congratulate both on your behalf and mine all the learned lecturers on the lucid and interesting manner in which they dealt with the technical and dry subjects and thank them for the same. Let me also congratulate the Secretary and the Members of the Madras Agricultural Students' Union on the successful manner in which they have conducted the proceedings of the Conference and on the happy conclusion of their celebration of the Diamond Jubilee of the introduction of Agricultural Education in India and the Silver Jubilee of their Union. When the Secretary read his report he appealed to the past students to join the Association in greater number and support its journal. I wish to add my appeal to his so that your Union and its Journal may continue to carry on the good work in promoting agricultural education and interests. (*Cheers*).

As soon as I entered the portals of the College on the 29th morning I saw the Guard of Honour provided by the students, drawn up in front of the portico in honour of His Excellency and their smart turn

out struck me very much. They are the products of this institution which is second to none both in Education and Research in this country. As they were standing in the sun, clad in civilian clothes, my first impulse was that they should be brought under the shade till His Excellency's arrival, but suddenly I realised that they are preparing themselves for their occupation later in life which will expose them to the rigours of the sun and rain. The hard training they get here has made them a sturdy and cheerful lot and it was indeed a pleasing sight to me to see them. I feel that this Institution could naturally feel proud of these young men and I am happy to think that I have been connected with such an Institution for the last five years and more. As sons of the soil and alumni of this college they have to deal mainly with the land and its problems and in doing so their training here will come in very handy.

I am glad to state that the results of the research work conducted here in various directions and under various heads have been many and good and it is up to you, my young friends, to carry them to the very doors of the ryot so that he may derive the maximum benefit from them. The Department has hitherto been dealing with the problem of helping the ryot to get the maximum out of the land with minimum of cost and labour but of recent years the additional and arduous task of finding suitable markets for the ryot to dispose of his produce has been thrown upon it. The problem of marketing the goods now-a-days is not an easy one especially to a Provincial Government which has no control over imports and exports, means of communications and currency. Prices of produce especially of commercial crops even in the most remote corners of this Province are controlled not by the fluctuations in Indian markets but, thanks to science which has so reduced time and space, by the ruling rates in the markets of far off cities like New York, Berlin and London. This problem is not merely provincial and national but also international. Instead of there being international co-operation there is international competition for armaments. Any moment the war clouds might burst, and if it does, I can only say "God help mankind". All this armament is meant merely to obtain special trade concessions for individual nations. What was more horrible was the attempt of various nations to requisition the services of science not to help humanity on its onward progress but to destroy mankind. I hope India's past civilisation, culture and her traditions will help scientists and others in this country to put the results of scientific research to better purposes than the one to which it had been put in the recent Great Wars. However, this problem has been receiving the close attention of both the Government of India and Madras Government and the Marketing Officers appointed by the respective Governments are making a complete survey of the marketing conditions throughout this land. As soon as it is finished the problem will be tackled in all its bearings on an All-India

basis. As far as this Province is concerned the Local Government have got a Marketing Board to advise them on marketing questions and in the case of cotton crops have established a market at Tirupur and the activities of its committee are being closely and carefully watched.

Another item which affects the ryots intimately is the problem of Life-Stock. This is also receiving the attention of the Local Government and the recent example set up by His Excellency the Viceroy in presenting two fine stud bulls and the great interest he has evinced in this matter has given a fillip to it. His appeal to the aristocracy and the leading men of landed classes has not been in vain. Madras has given, I believe, the lead in this matter, in that some gentlemen have announced their intention to purchase and maintain stud bulls at their cost. The Department on their behalf is arranging for the purchase of animals suitable for the respective localities. Some local bodies also are interesting themselves in this direction. I would appeal to Mr. R. M. Palat, President, District Board, Malabar, who is present here to interest himself in this matter. In fact there are two or three big schemes under consideration of this Government and their expert advisers just now for improving the different breeds in this province.

For want of time I have mentioned only two or three items now. As regards the work of the Agricultural Department itself in helping the ryot to better his position if I were to enumerate them to you it will be like sending coal to New Castle.

The one problem that is causing great anxiety to all the Provincial Governments as well as the Central Government is the unemployment amongst the educated young men. Within the last 10 years or so not only arts colleges but also professional institutions have turned out more men than Government and private employers could absorb. It has been suggested that a change in the present system of education might remedy this evil. I am doubtful whether even a radical change will bring about the desired result. Nevertheless, the fact remains that there are a large number of educated young men whose services could be utilized with great advantage to themselves and the nation. Further, the State has a right to the service of all able bodied men and women, educated and otherwise, at all times. If during times of war their services could be requistitioned, as was the case in Europe and other countries during the last Great War, why could they not be utilised in times of peace also. Their employment even on a bare sustenance allowance might cost the nation a considerable sum and the present finance of this Province might not admit of it. This question requires careful handling and it will be almost the first task of the Ministry under the new dispensation. All the same this Government are fully alive to their responsibility and are arranging for the training of 150 educated men in the agricultural farms in the various districts for a period of 4 months. I hope and trust that this offer will be fully

availed of by young men and they in their turn will help agricultural improvement. This is only an earnest of the Government's interest in this problem and the first step in its solution. (cheers).

The Secretary of the Union in the concluding paragraph of his report has stated that a large number of agricultural graduates are still without employment. I am fully aware of this. I may mention that three years back I informed the Director of Agriculture and the Director of Veterinary Services to inform the intending candidates that they should not expect any employment under Government. Be that as it may, I may just inform you that Government are considering the question of giving effect to the programme of having a demonstrator in each taluk. As soon as the Legislative Council accepts the proposal about 40 new demonstrators will be recruited. I believe this will give relief to some extent to the unemployed agricultural graduates (*cheers*).

I wish to take this opportunity to congratulate our young friend Mr. Mahadevan, an ex-student, who has started a private farm at Kotagiri, on his venture, a venture which deserves our praise and help. Several speakers who took part in the discussions the previous day stated that Government did not give sufficient encouragement to private enterprise. I may at once tell these critics that Government gave help whenever and wherever there was a need for it. I can quote instances, though I cannot give figures off hand now where Government gave help to several institutions both in the shape of monetary grant and services of officers. So long as this help was forthcoming everything went well but the moment this was withdrawn, as it could not be continued indefinitely, the whole fabric of those Institutions crumbled to pieces. Let me take the case of Chintaldevi Cattle Farm. As a measure of retrenchment this farm had to be closed about 1932, distributing the work done there to other farms elsewhere. As Minister in charge of Public Works, I had to dispose of the building. Before so doing I sent for the Director and asked him whether he could not persuade the agricultural graduates and others to settle down there and start an Agricultural Colony. His attempts to do so failed and I am sorry to say failed miserably. Mr. Mahadevan told his friends while persuading them to follow his example that farming requires hard work. I quite agree with him that it is not an easy matter. Self help is the best help and God helps those who help themselves. Government however will be only too glad to help those who come forward to start any venture which will be in the interest of the nation. As regards Mr. Mahadevan I am quite sure the Departments of Agriculture and Co-operation will give him all the help they can.

In the course of the discussions reference was made to the Provincial Economic Council and the District Economic Councils for

rural reconstruction. These bodies are meant to help the villager to improve his lot. In this, the Department of Agriculture can play a great and important part. Now, gentlemen, I wish to acknowledge the help and co-operation readily and willingly given to me by the officers of the Department ever since I assumed ministerial responsibility. Might I also acknowledge the services of Mr. S. V. Ramamurthi as Director of this Department. He gave a new orientation to the work and out-look of the Department; and this he was able to do because he enjoyed the full confidence of the officers of the Department and received their co-opertion and help freely. (*Cheers*).

Now, ladies and gentlemen—In the last two decades after the Great War every nation has been looking to its younger generation for reconstructing the society. Though India had not suffered to the same extent as other nations, yet, she too has been putting her faith in the younger generation. We of the past and the present generation are holding India's destiny and future in trust for you and we shall hand it over to you the moment you are ready to take up the responsibility. In this view I appeal to you, my young friends, the students and the graduates of this great Institution to spend your energy and time in creating a new rural India where dirty and filthy hovels called villages and their miserable occupants will disappear and in their place shall arise new villages and a new generation of men who will devote themselves to the service of humanity and to the glory of India. In this arduous but noble task that is ahead of you, you have the blessings of your elders and I for my part wish you every success. (*Cheers*).

The Cecil Wood Memorial.

(*Portrait Unveiled*)

Mr. K. Ramiah, Paddy Specialist, made a statement in connection with the portrait in the course of which he recalled the services of Mr. Wood to the cause of promoting agriculture in the Province. Mr. Wood as Principal of this College, the speaker continued, had been responsible for all the developments associated with this institution for the first twelve years. He was a disciplinarian and an officer of boundless energy. He always laid great stress on practical agriculture and in the maintenance of field observation books. He compelled students to take part in some game or other and himself took part in them. Being a hard worker himself, he always expected a very high standard from his subordinates. Mr. Wood was the first President of the Union and had played a great part in moulding its early activities. Some of his old friends desired to perpetuate his memory in the College to which as Principal he had done so much. A committee was appointed which passed resolutions for instituting a suitable memorial for Mr. Wood, that an oil painting be presented to

the college, that a medal be awarded to the best student in the College, that an endowment be made for scholarship to be granted to a deserving student in the College and that a prize be awarded annually for the best paper on agricultural and economic life of any tract in this Presidency. In response to the appeal, a large number of donations had been collected. Realising the importance of this occasion, it was decided to present the portrait for unveiling to-day. It was very appropriate that the present Director who was closely acquainted with Mr. Wood should unveil the portrait. He appealed to all old students of Mr. Wood and his colleagues to come forward with donations so that the Committee could carry out its objects, set forth above. The amount so far collected was Rs. 255.

Director's Speech.

Mr. Ananda Rao, in unveiling the portrait, said that his acquaintance with Mr. Wood started from the day he started his official life in the Department. Mr. Ramiah had said so much that little remained for him, the speaker, to say further about Mr. Wood. As had been said, Mr. Wood was remarkable for industry and organisation. Many things that Mr. Wood did had stood the test of time. His interests in students and their sports was very great. He was also of a very sociable nature. This function, the speaker thought, was long over-due. He was glad that he had been given the privilege of unveiling the portrait and he had great pleasure in performing it.

He then unveiled the portrait of Mr. Wood amidst cheers.

Vote of Thanks

The Principal Mr. R. W. Littlewood in proposing a vote of thanks, at the close of the session said :—

It now devolves on me as President of the Madras Agricultural Students' Union and as the head of the Agricultural College to offer my heartfelt thanks to you Sir, the President of this Conference, for presiding over and conducting the deliberations and bringing them to a successful close. It is very gratifying that one who is born in the Agricultural community and who is Minister in charge of the portfolio of Agriculture, should have graced us with his presence on this occasion, and evinced a keen interest in all the events.

To you Sir, as Development Secretary, in the midst of your multifarious duties, your presence here on this occasion is very much appreciated.

To you, Sir as Director of Agriculture, we are grateful indeed for all the keen interest you have evinced in the successful running of the College Day and Conference.

To all Ladies and Gentlemen, who have responded to our invitation and helped us in several other ways on behalf of myself and that of the Union, I offer my sincere thanks.

Proceedings.

Proceedings of the General Body Meeting of the Madras Agricultural Students' Union held on Saturday 1st August 1936 with Mr. R. W. Littlewood in the chair. 90 Members were present.

The Secretary read the minutes of the last General Body meeting, which was passed by the General Body.

The Annual Report and the Auditor's Report were then presented by the Secretary. Dr. J. S. Patel moved and Mr. K. Krishnamurthi Rao seconded that the report be adopted.

The Budget for the next year was then taken up. Several people took part in the discussion, Messrs. M. S. Kylasam, M. R. Balakrishnan, T. Varahalu and P. Bagirathi Padi being the prominent, the chief point on which information was elicited being on budget provision of Rs. 400 under establishment. The Secretary and the Treasurer answered the points raised. Mr. M. R. Balakrishnan moved and Mr. Adisesha Reddy seconded that 'Rs. 450 under College Day be increased to 650 to enable the committee to either repair or replace the curtains and other fittings for the stage.' This was passed and the budget as so modified was adopted. Rao Sahib V. Muthuswami Iyer then moved the following resolution; "That this General Body meeting requests the Director of Agriculture to move Government about making statutory provision for the free grant of lands wherever available and the necessary funds to agricultural graduates to form colonies in rural areas, so that these may serve as demonstration centres." He made a lengthy statement, stressing on the necessity of finding employment for graduates, the duty of Government, the availability of cultivable waste land and quoted instances from Denmark where in such schemes Government had taken the initiative.

Several people Messrs. K. Ramiah, K. Krishnamurthi Rao, K. Unnikrishna Menon, Bagirathi Padi, M. U. Vellodi, Rao Sahib T. V. Rajagopalachari and K. Raghavachari took part in the discussion, the general sense being that while the General Body was in sympathy with the spirit of the resolution preliminary work must be done by the Union or a recognised body to marshall facts and figures, before Government and the Director of Agriculture are approached, so that we may equip ourselves to meet arguments. It was also felt that a real desire to go back to the land was not evinced by the Agricultural graduates. Mr. R. W. Littlewood mentioned the instance of Chintaldevi also quoted by the Development Minister, and the Secretary mentioned his experience that not one Agricultural graduate answered an advertisement the previous year to work up a private Mirasdar's lands. Mr. K Unnikrishna Menon and Mr. Bagirathi Padi brought two amendments the former to add "and for employment in the Co-operative and Registration Departments" and the latter to add "and for employment as Panchayat officers and as District Board Educational officers." These amendments were later withdrawn at the suggestion of the President, as it was generally felt that the spirit of relief sought in the original resolution was not the same as that of the amendments. Mr. G. Jogiraju then brought another amendment as follows "to delete all the portion of the sentence after Agricultural graduates in the resolution, and to add" that a committee consisting of V. Muthuswami Iyer, T. V. Ramakrishna Iyer, K. Krishnamurthi Rao, G. Jogiraju, the Secretary and the Vice President of the Union be formed to prepare an elaborate note as to how the objects could be achieved, for forwarding with the resolutions to the Government."

The amended resolution was passed by a large majority.

The Secretary then brought to the notice of the General Body instances where "old boys" on the unemployed list wished to be given the concession rates of subscription available for students. After some discussion Mr. M. R. Balakrishnan moved and Mr. K. Krishnamurthi Rao seconded "that this General Body

empowers the Managing Committee to extend to such unemployed old boys of the College as require it, the concession rate of subscriptions applicable to students under rule 2." The resolution was passed unanimously. The forthcoming office bearers were then elected for the coming year.

Council.

President.
Resident Vice President.
Editor.
Secretary.

Mofussil Vice Presidents.

Mr. K. Gopalakrishna Raju.
Mr. K. Unnikrishna Menon.
Mr. G. Jogiraju.

Mofussil Members.

Mr. K. T. Alwa.
,, C. V. Saravayya.
,, C. Ramaswami.
,, K. S. Ramanna Rai.

Resident Members.

Rao Sahib Dr. T. V. Ramakrishna Iyer.
,, V. Muthuswami Iyer.
,, T. V. Rajagopalachari.
Mr. D. V. Krishnaswami Naidu (Student).

Editorial Board.

Mr. V. Ramanatha Iyer—Editor.
Secretary.
Manager.
Dr. J. S. Patel—Member.
Mr. K Ramiah.
,, M. U. Vellodi.
,, T. K. Subrahmaniam (Student).

Managing Committee.

Rao Bahadur G. N. Rangaswami Iyengar—Resident Vice President.
Editor.
Secretary, Mr. S. M. Kalyanaraman.
Treasurer, ,, M. A. Sankara Iyer.
Manager, Mr. R. Balasubramaniam.
Mr. C. S. Krishnaswami—Member.
,, T. S. Lakshmanan ,,
,, S. Ramachandran ,,
,, Pinto (Student) ,,

The President thanked the various committees, who helped in the celebration of the College Day and Conference, including the Hostel Warden, the Superintendent of Central Farm, the Estate Mechanical Engineer and the Principal of the Forest College.

Rao Bahadur S. Sundararaman proposed a hearty vote of thanks for the President Mr. R. W. Littlewood. Rao Sahib V. Muthuswami Iyer proposed that the thanks of the General Body be recorded to the retiring committee.

THE REPORT OF THE MANAGING COMMITTEE

The Managing Committee have great pleasure in presenting their report for the year 1935-36.

Membership. The strength of the Union as it stood on 31st May is 550 (with 120 subscribers.)

Meetings. There were two meetings, one on Agriculture in Burma, by Mr. K. Ramiah, and Rice cultivation in Bengal by Mr. Banerjee.

Another meeting was convened under the auspices of the Union and other associations to move a resolution of condolence on the death of His Majesty.

Working Committee meetings. 10 meetings of the Committee were held.

Jubilee celebrations. The Committee began making preparations for this event immediately after the last College Day, and supported by the Director of Agriculture sought a financial grant of Rs. 3000 from Government. But unfortunately our request was negatived and the Union had perforce to fall back on its own resources, to meet the expenditure in connection with the event. A meeting of the Council, to which were invited representative officers of the department was convened and it was informally agreed that His Excellency the Governor be invited to inaugurate the proceedings and the expenses regarding Lunch and Tea be borne by the well wishers of the Union. (Our Director kindly undertook to provide the Lunch and the Gazetted officers the Tea for His Excellency during his stay). We take this opportunity to thank them for rendering this aid to the Union.

Ramasastrulu Munagala Prize. Four papers were received and Mr. T. Varahalu was awarded the medal for his thesis on 'Studies in sugarcane, effect of environmental conditions on the growth of cane'. The thanks of the Committee are due to Mr. Munro, (President), Rao Sahib T. V. Rajagopalachari and Dr. V. K. Badami for acting as judges in this competitions.

The Journal. The Journal maintained the high standard set up in previous years and the Managing Committee have great pleasure in recording the invaluable services rendered by Mr. K. Ramiah and the members of the Editorial Board who were responsible for the publication of the journal. The Committee have also to record their appreciation of the promptness of our printers, The Scholar Press.

Finance. The auditor's statement is before you. Our finances have shown improvement and we had on 31st May a cash balance of Rs. 1196-4-4 after meeting our liabilities up to date. No doubt a little of this surplus will be utilised to meet the expenses of the Jubilee celebrations, but the financial situation is encouraging and we hope that future Committees will endeavour to stabilise it more firmly. Our Vice President, Mr. S. Sundararaman was conferred the Title of Rao Bahadur and Mr. C. Narayana Iyer the Title of Rao Sahib and Mr. F. H. Butcher, O. B. E. We tender our congratulations to these gentlemen.

Our heart-felt thanks are due to Mr. R. C. Broadfoot and Mr. R. W. Littlewood who as Ex-Officio Presidents, took very great interest in the affairs of the Union, and guided it during the year. To Mr. R. W. Littlewood our thanks are specially due for he had to bear the brunt of the heavy work involved though he assumed charge just a month previous to the Jubilee celebrations.

The Union owes a deep debt of gratitude to Rao Bahadur D. Ananda Rao without whose sympathetic support in our endeavour to celebrate the Golden Jubilee of Agricultural Education and the Silver Jubilee of the Madras Agricultural Students' Union, the function would not have been a success. Our thanks are due to the various Committees who helped us during the College Day last, to Mrs. Cherian. Mrs. Charley and Mrs. Raghavan and to Mr. Davis of the Forest College.

List of Winners of Different Prizes for the year 1935-1936.

1. **The Robertson Prize.** *The premier prize* of the College and is awarded to the student who obtains the highest number of marks in the subject of *Agriculture* in the *Final Examination* for B. Sc. Ag. Degree at the first appearance. Won by A. Raghavan.

2. **The Clogstoun Prize.** This prize is for '*General Proficiency*' and is awarded to the student who obtains the highest number of marks in all the College Terminal Examinations of the B. Sc. Ag. Course. Won by G. Venkataramana.

3. **The Keess Prize.** The prize is awarded to the student who obtains the highest number of marks in *Agricultural Chemistry* of the *final examination* of the B. Sc. Ag. Degree. Won by K. Rajabapanayya.

4. **The Sampson Memorial Prize.** This is awarded to the student who obtains the highest number of marks in the subject of *Botany* in the *final examination* of the B. Sc Ag. Degree. Won by T. Arunachalam.

5. **The Dewan Bahadur R. Raghunatha Rao Prize.** Awarded to the student who obtains the highest number of marks in *Practical Agriculture* as judged on the highest number of marks obtained in all the College Terminal Examinations and in Practical Agriculture of the final examination of the B. Sc. Ag. Degree. Won by A. Raghavan.

6. **The D'Silva Memorial Prize.** Awarded to the student who obtains the highest number of marks in *Animal Hygiene* of the Second Year Examination of the B. Sc Ag. Degree. Won by S. Mahadeva Ayyar.

7. **The Goschen Prize.** Awarded to the student who obtains the highest number of marks in *Agricultural Zoology* of the Second Examination of the B. Sc. Ag. Degree. Won by T. N. Anantanarayanan.

8. **The Anstead Prize.** Awarded to the student who stands first in B. Sc. Ag. Class II in *Plot Cultivation* (Wet, Dry & Garden), provided he passes the first and second year B. Sc. Ag. classes at the first appearance. Won by P. M. Syed.

9. **The Rao Bahadur K. S. Venkatarama Ayyar Prize.** Awarded to the best student in B. Sc. Ag. Class I as judged from marks obtained in the First Examination of the B. Sc. Ag. Degree. Won by P. Narayanan.

10. **The Certificate Course Cup.** Presented to the student who obtains the highest number of marks in *Agriculture* in the Second Examination of the B. Sc. Ag. Degree. Won by J. Raghottam Reddy.

11. **Old Cuddapah Dt. Agrl. Association Prize.** In the form of books is awarded to the best student coming from the Ceded Districts comprising Bellary, Kurnool, Anantapur and Cuddapah Districts and Taluks of Vayalpad and Madanapalle of the Chittoor District. Won by (i) Shaik Abdul Hafiz, (ii) A. V. Parthasarathi, (iii) R. Ali Hyder.

12. **Sir T. Vijayaraghavachariar Medal.** Awarded to the student who obtains the highest number of marks in *Agricultural Engineering* of the Second Examination of the B. Sc. Ag. Degree. Won by S. Krishnananda Sastri.

13. **M. K. Nambiar Prize.** Awarded in the form of books to a student who obtains the highest number of marks at the Second Examination of the B. Sc. Ag. Degree at the first appearance. Won by T. N. Anantanarayanan.

Exhibition.

In connection with this Years' College Day and Conference a comprehensive exhibition illustrating the various activities of the Department and the results achieved was put up in the Freeman Building. The exhibition was opened by His Excellency the Governor on 29th July and was kept open for the public until 2nd August. Among the notable visitors may be mentioned Hon'ble The Minister for Public Works, The Hon'ble Home Member, The Secretary to Government Development Department, The Collector, Coimbatore, Hon'ble V. C. Vellingiri Gounder and the local members of the Madras Legislative Council. The exhibition was made up of several sections according to crops and departments of research, arranged by the Heads of Sections in the Research Institute. Exhibits of Crops sent by circle officers were grouped along with the exhibits of particular crop specialists but such of them not handled by research officers were grouped into a general section arranged by the Superintendent, Central Farm. An account of the exhibits put up in the different sections is given below :

Chemistry. This section exhibited results of work in a few of the many lines of work, which were of immediate interest by means of posters, diagrams and material exhibits.

The Cream Jaggery stall showed jaggery made by the new process using paddy husk carbon, from cane juice and coconut and palmyrah juices. The jaggery made by the old process were shown side by side to show the attractive colour of the product made by the new process. In the same stall were shown details of the process of making active carbon from paddy husk, and its many and varied uses.

The Nutrition stall had posters of the requirements of animals, and a collection of human and animal foods with details of composition. The "Molascake" Exhibit showed samples of a compact and easily handled brick made out of

molasses oil cake and mineral mixture. This cake was made to contain 125 grams of digestible protein in one pound brick, one brick, fed with straw *ad-lib* being sufficient for the maintenance of a bullock of 1000 lbs. live weight as found by experiment here. This method of making use of molasses, now a step-son of the sugar industry, has great possibilities.

The microbiology stall had a working model of the activated sludge plant, showing the various parts and the mode of aerating the sewage. Other exhibits of the stall consisted of diagrams, photographs of the legume nodule and the effect of inoculation on growth and yields and another exhibit showed the deterrant effect of the Saprophyte-Aspergillus on the paddy foot rot fungal parasite *fusarium*.

The Malting stall had exhibits of malt foods made from Cholam, and their comparative value when compared with imported malt foods. An Exhibit of bread made by blending malt Cholam with wheat flour was also shown. Charts and posters of the malting process, showed the simple process pictorially.

Mycology. Among the mycological exhibits put up at the show the following important items are worthy of mention.

Fungus diseases of crops and fruit trees. Mahali disease of Arecanuts, Budrot of palms, Blackshank of tobacco, Footrot of paddy, and Sarut and Redrot of sugarcane—Charts and live specimens showing the symptoms of the disease and posters indicating the remedial measures were put up.

Virus diseases. Charts showing Mosaic of sugarcane, cardamom, plantain, and maize and sterility disease of cotton were exhibited.

Fruit diseases. Charts—Plantain wilt and fruit rot, Citrus folliocellosis and pink disease, scab etc. were shown.

The technique about the use of fungicides and sprayers was explained.

In addition to the above, the various processes in microtome sectioning of materials and the apparatuses used in the determination of H-ion concentration of solutions were also shown. A demonstration of the latter was also conducted.

Entomology. A special feature of the Entomological Exhibition was the display of live insect pests in all their developmental stages with their appropriate food crops. This facilitated a layman to get to know them in their perspective and association and appreciate the remedial measures suggested under each item. These were further supplemented by self explanatory coloured plates and posters.

The exhibits included a wide range of pests and useful insects and the following were a few of them.

The orchard pests like the fruit flies *Dacus cucurbitae*, Coq and *D. ferrugineus incisus*, Bez., the fruit sucking moth *Obhideres materna*, L., and the mango hoppers *Idiocerus* spp which are a menace to successful fruit cultivation, were well represented to show in what phase of their life, they are harmful. There was shown the much dreaded groundnut red hairy caterpillar *Amsacta albistriga*, M which is a menace to groundnut cultivation in most of the districts especially S. Arcot, Salem, etc., the remedial measures were aptly indicated with appropriate coloured plates. There were then the pests of garden crops. The chillies leaf curling thrips *Scirtothrips dorsalis*, Hd , and the brinjal leaf eating lady bird beetle *Epilachna* formed instructive exhibits showing the nature of damage done to each crop.

Pests of sugarcane formed an equally interesting exhibit. The moth borers *Diatraea sticticraspis. D. venosata*, W and the top borer *Scirpophaga monostigma* were set up to show how as larvae they bore into the stems and cause dead hearts. The nature of damage done by cane fulgorid *Pyrilla perpusilla* which is a bad pest in S. Arcot was well indicated.

That plants are equally susceptible to virus diseases was well exemplified by the exhibited diseased cholam plants affected with 'freckled yellows and stripes' for which the cholam shoot bug *Dicranotropis maidis* (*Pundaluoya simplicia*) is the insect vector.

The cotton bollworms both the pink and the spotted and the pests of paddy like the paddy grasshopper *Hieroglyphus banian*, Fb. and the rice bug *Leptocorisa acuta* very vividly brought out the nature of the damage to cotton bolls and paddy crop; coloured plates were exhibited to show how to combat these crop pests.

To demonstrate the possibilities of employing natural enemies of the crop pests to subdue them, the classic instance, i.e., the imported Australian lady bird beetle *Vedalia cardinalis* against the devastating fluted scale *Icerya purchasi* and the Bethylid parasites *Perisierola serinopae* against the familiar coconut leaf eating caterpillar *Nephantis serinopa* were well exemplified by appropriate specimens.

Useful insects which form the basis of some of the cottage industries like Bee-keeping, Lac culture and Sericulture, formed fascinating exhibits. Of these cottage industries, Bee-keeping was particularly instructive. Hives with bees and live specimens of the different varieties of Indian honey bees and their enemies formed an interesting aspect of the exhibition. Along with these, bee-keeping appliances such as honey extractor, etc., and samples of honey from different sources attracted considerable interest.

Coming to sanitation, the control of the ever menacing housefly *Musca nebulo* in both the adult and maggot stages was indicated with instructive models and drawings.

The common insecticides in use together with dusting and spraying appliances formed yet another interesting section of the exhibits.

Paddy. Among the many exhibits put up in the paddy section illustrating the improved methods of paddy growing and the general plant breeding technique, may be mentioned the following:

Specimens of the strains evolved at the Coimbatore Paddy Breeding Station and at the Sub Stations of Maruteru, Pattambi and Aduturai with their rice samples and charts showing the areas in the different parts of the Province where particular strains have been found to do well. A map of the Presidency illustrating the spread of the above strains in the different districts, with posters showing the value of the increased yield estimated by the extent of such spread. Mounted charts, and plant specimens of strains evolved by hybridisation for higher yield with definite economic value as (a) stiff and long straw (Co. 3 Burma variety) and (b) with the capacity to resist (piricularia) a fungus disease which is responsible for a great loss in the Tanjore delta. Exhibits of raw, shelled, polished and par-boiled rices together with posters explaining the nutritive value of non-polished rices. Cooking investigations in relation to the quality of the produce stored in different ways attracted the attention of the onlooker. Rice seedlings grown in wooden boxes and mounted specimens of heads as well as photographs drew the attention of the public regarding the changes that could be brought about by X-rays—a recent method to induce germinal changes in plants. Among the several mutants obtained by subjecting the seed to X-rays, there was also one showing greater prolificacy and extended duration. The special mutant where the gene controlling the geotropic movement of the shoot had been disturbed by X-ray was also shown. Potted plants of wild and interspecific hybrids illustrating the possibilities of introducing vigour and resistance to drought, disease etc. in the cultivated varieties by repeated back crossings. Progenies of an intervarietal cross in chillies for the investigation of size and pungency and the obtaining of big fruits with greater pungency. Green manure plants of Sesbania Specisa (4 month's duration) reaching

a height of over 12 feet. This crop a new introduction from Kenya, the seeds of which were kindly supplied by Mr. H. C. Sampson, is full of promise.

Millets. The Millets Section put up an instructive exhibition illustrating the general features of millets and the work of the section. Millets occupy about 14 million acres in the presidency. They are grown in areas of poor rainfall. In the districts, the area under millets is generally found to be inversely proportional to the area under paddy. Millets are peculiar in flowering, to a great extent, during night time. Suitable charts were displayed to bring out these peculiar features of millets.

Earheads, grain and rice or flour samples were exhibited in all the eight millets--*cholam, cumbu, ragi, tenai, arika, samai, panivaragu* and *kudiraivali*. In the first four major millets a number of varieties both Indian and foreign were on show. Varieties in sorghum which were good for popping, malting, or resistant to striga were also exhibited. The various strains evolved in sorghum both at the Millets Breeding Station and at the Research out-station at Nandyal were displayed. In *ragi* there were three good strains of three different durations. In *cumbu*, the new introductions, the Punjab *cumbu* and the Jamnagar giant attracted much attention. Earheads of the millet strains grown in the fields of ryots in the neighbouring taluks were received from the Deputy Director of Agriculture, VIII Circle, and exhibited.

There was a small section devoted to the poor man's pulses, lablab, horsegram and cowpea. Many varieties in each of them were on show.

Cotton. The importance of the cotton crop to the Indian agriculturist and the efforts that are being made by the Cotton Specialist and his staff to improve the condition and prospects of this crop were well brought home to the public by exhibits of various kinds, like posters, placards, illustrated charts, cartoons, a large number of actual samples and a few live specimens.

The important cotton varieties of the Presidency were exhibited in neatly designed wooden boxes with full details regarding their commercial qualities. The present position of India among the cotton growing countries and of Madras among the several provinces formed the subject of a series of illustrated charts which showed how India, though second in production only to U. S. A., occupies a vulnerable position because of her short staple and what Madras with its wealth of high-stapled varieties can do to restore her balance.

Other aspects of cotton culture—such as rotation, protection against pests, clean and profitable marketing and the several ways by which the section is attempting to increase the profits of the ryot through increased knowledge also received their due share of attention.

The future of Indian cotton was the central theme of an interesting carton of a world cotton parliament, pointing to the great and immediate need for fortifying India's position against the present day dictators and her probable competitors.

Samples of two interesting side lines—Red and Bengal grams—to which also the attention of the section is devoted-were exhibited, showing the multitudes of forms and variety of colours that are present.

Oil-Seeds. Live plants and seeds of groundnut varieties, Local Mauritius, Saloum, Gudiyatham Bunch, *Arachis mozambiquarae*, *Arachis rosteiro* were exhibited. A chart indicated the performance of A. H. 25, Saloum groundnut in different districts. Live plants and photographs of different forms of habit were exhibited; and among these the most interesting was the trailing type evolved through hybridization. The photographs of the root systems showed that the Saloum variety had better root system than the Local Mauritius and generally the roots

of bunch types penetrated deeper than the roots of the spreading types. Coffee made out of the parched groundnuts and the biscuits made out of the groundnut cake were some of the new products exhibited.

There were live demonstrations of the rotations to be followed and the mixtures to be grown along with the groundnut.

Different types of coconuts, dwarf and tall coconut seedlings and various grades of copra were exhibited. Among the F_1s of the crosses, the crosses between the dwarfs and tall types were outstanding. Attractive playcards drew attention to the necessity for (a) clean cultivation of the coconut and (b) for, manuring with 3 lb of ammonium sulphate and 20 lb. of ashes per palm.

Different varieties of castors, gingelly and cashew nuts were exhibited.

Sugarcane. A feature of this section was the specimens of canes from the districts, the outstanding varieties being Co. 419 and Co. 421 which were exhibited along with the standard canes Poovan, P. O. J. 2878 and Co. 213. The variety Co. 419 is a typical wet land cane which has been reported to have done well at the Padegaon Experiment Station in the Bombay Presidency, at Jorhat in Assam and at Pyinmana in Burma. At Anakapalle and Samalkot it is expected to replace varieties like J. 247 (247 B), B. 208, and Purple Mauritius. Co 421 is a variety which grows vigorously under relatively dry or semi-irrigated conditions and has given a very satisfactory account of itself in more than one experiment station in North India. In South India it is worth a trial in places where Co. 213 is being or proposed to be grown. Specimens of canes grown at Anakapalle were also exhibited.

The rapid increase in sugar production during the last six years from 311,000 to 770,000 tons, the fall in the import of foreign sugar from 940,000 to 223,000 tons the increase in the number of sugar factories from 35 to 155, the increased profit to the cultivator by growing the Co. canes and the spread of Co. canes which now occupy over 61% of the total area under this crop, were vividly brought out by interesting charts to show the present position of the Indian Sugar Industry.

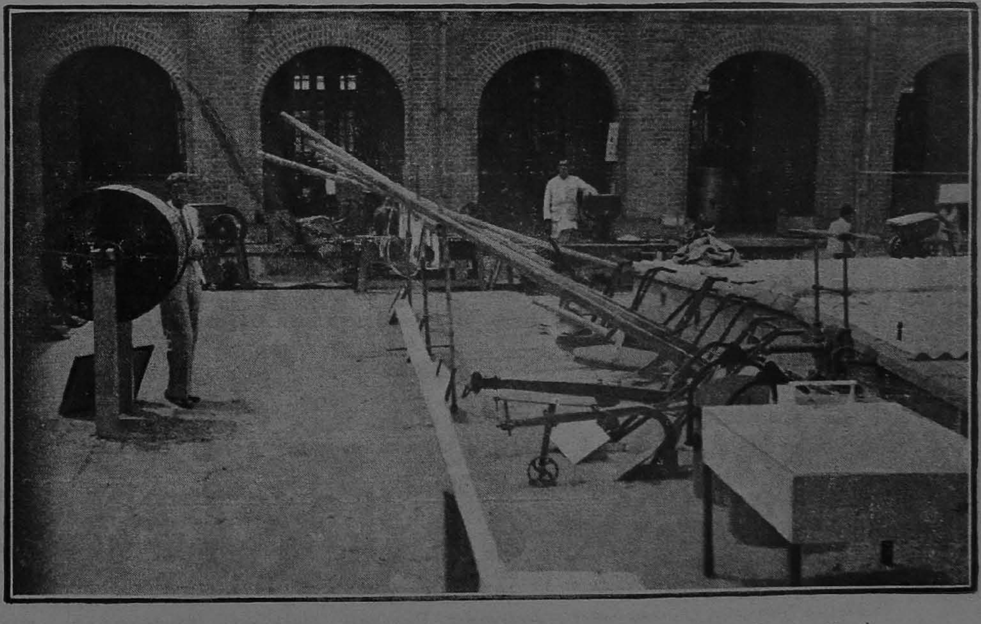
Not the least interesting were the charts showing the methods adopted at the Imperial Sugarcane Station, Coimbatore, for evolving improved sugarcane varieties. It is the increased yields thus obtained that has yielded the needed raw material for the recent renaissance in the Indian Sugar Industry.

Engineering. The Agricultural Research Engineering Section exhibited a wide range of implements and machines designed or adapted to meet the particular requirements of the ryot. The exhibits included light and medium weight cast chilled and steel ploughs, guntakas, buckscrapers, light steel ridge ploughs, harrow, ball bearing mhote wheel, chaffcutter and fodder chopper, McCormick Deering 5-typed expanding cultivator, a bund forming implement, cast iron fire bars for jaggery furnaces, a Richmond and Chandler groundnut decorticator, a grain polishing and cotton seed delinting machine, a turmeric polishing machine, a hand-operated paddy hulling machine of Japanese manufacture, a Persian wheel bucket wheel and buckets, a model of the improved circular mhote water lift, a mechanical seed drill, a 2 tons capacity rubber-tyred cart, and a Burmese puddling implement.

Systematic Botany. A. *Madras Bananas.* Banana fruits of all the 51 known varieties of the Presidency preserved in their natural colour by a special process with photographs and life-cycle charts for each, along with their standardised names. The fruits of the wild parents of both the rounded and angular bananas collected from the Hills of the West Coast with their viable seeds. A dozen banana bunches with "trees" of the most promising varieties such as, *Kapur, Thattilla Kunnan, Chakkarakeli, Ayiranka Rasthali, Batheesa, Monthan,* etc., with

COLLEGE DAY EXHIBITION

1936



(Views of the Agricultural Section & Research Engineer's Section).

short descriptions. Flour of 6 varieties of bananas along with an analytical chart comparing this composition with wheat and rice. The flour of one variety, *Adakka Kunnan*, contains protein double that of the flours of the other varieties. It is this flour that is used as an infant food in the West Coast. Banana products from the ripe fruits, such as, Jam, Jelly, Halva, "Figs" and from the unripe fruits, such as, Crisp, Banana "nut", etc. and painting showing the stage in which the bananas are to be eaten banana "figs" and fruits received from the Agricultural Research Stations of Aduturai and Samalkot.

B. *Forage Plants*. 10 indigenous fodder grasses in pots along with their chemical analysis. Of these, the following are the hill grasses that are thriving in the plains :—*Sehima nervosum*, Stapf., *Chionachne semiteres*, Fisch., *Chionachne Koenigii*, R. Br. and *Enteropogon monostachyos*, K. Set.

10 varieties of Lucerne in pots received on exchange relations from Leningrad. Of these, the Armenian type has a spreading habit and therefore it may prove a good mixture in the pastures.

General. This general section consisted of posters and photos of Livestock to show the importance of cattle breeding, the use of good stud bulls, the advantage of having pedigree animals and the progress and help given by the department to improve livestock by giving premium, also posters showing proper rations for milk animals, dry animals, breeding bulls and work animals. Similarly information on Poultry-keeping was also supplied. Eggs of different quality were exhibited. Handling of milk was exhibited and practical demonstration of testing milk for quality was given. The most attractive portion in this section was the display of the various kinds of fruits and fruit preserves and a large collection of vegetables both indegenous and english. The material included both those grown at the Central Farm and those brought by the Curator, Government Gardens, Ootacamund. A good collection of potato varieties from the Nanjanad Station was also exhibited in this section. Coffee plants, tea of various grades, cardomom, arecanuts, etc. from the seventh circle were also on show.

Horticulture. Besides the exhibits of fruits in the General Section the Superintendent, Fruit Research Station had organised a miniature orchard with live material explaining the various aspects of fruit growing from the preparation of the nursery, sowing of seeds, etc., to the picking and packing of fruits.

Some of the local practices observed in the orchards and the comparative proper methods to be followed were demonstrated. in the plots prepared for the purpose. The exhibits started with the propagation by seed from the extraction and selection of good seed; defective and proper methods of preparing the nursery to sowing and transplanting of seedlings under various stages. Vegetative propagation by cutting, layering, gotteeing, budding and grafting with different operations involved were also demonstrated, but with special reference to budding and grafting. Selection of reliable and good plants for orchards, various methods of planting, irrigation and manuring, clean cultivation and pruning, formed some of the instructive items of demonstration. The local and standard methods of picking, grading and packing of fruits were also exhibited.

Placards with instructive notes on various pomological operations were kept in the stall as a guidance to the visitors and due attention was given to the practical demonstration of all aspects of fruit growing.

College-day Sports.

The athletic sports in connection with the 25th College Day were held under the auspices of the Union on Saturday, the 1st August '36. The ground was gaily decorated and the Union Jack hoisted in the middle of the ground. Further attempts to add to the adornments of the ground by way of flags and streamers

were frustrated by a strong breeze which persisted throughout the day. The entirely new set of athletic equipment contributed its share to the elegant appearance of the course. The weather conditions were very favourable though interrupted by two spells of light showers which however did not seriously interfere with the conduct of the sports.

The sports commenced puctually at 3 P. M. and all the 22 items were gone through by 6-15 P. M. Each one of these was very keenly contested though no new records were created. The astonishing feature of this year's contests is that the champion was undecided till the last individual event was over. Messrs. M. Mukundan and K. Kunhiraman Menon went all out to win the coveted honour but Mr. Mukundan succeeded in retaining the title which he won last year by securing 42 points as against 40 scored by Mr. Menon. It is interesting to mention that Mr. Mukundan secured three first places and four third places to attain the aggregate of 42, whereas Mr. Menon scored four first places to total 40.

After the sports were over Mrs. R. W. Littlewood very kindly distributed the cups, medals and prizes to the respective winners. Rao Bahadur S. Sundara Raman, Vice President of the Union thanked Mrs. Littlewood for readily accepting the invitation to preside at the function, and called for three hearty cheers which were enthusiastically responded.

The sports committee takes this opportunity to convey its thanks to all the gentlemen who rendered invaluable help in conducting the sports by readily accepting the various offices to which they were elected and discharging their duties connected therewith ungrudgingly.

List of Prize Winners.

Cross Country:
i. S. K. Sastry.
ii. T. M. Kini.
iii. Md. Zainulabudeen.

100 Yds. dash:
i. K. K. Menon.
ii. P. M. Somanna.
iii. M. Mukundan.

Long Jump:
i. M. Mukundan.
ii. T. M. Kini.
iii. P. M. Somanna.

Shot Put:
i. K. K. Menon.
ii. T. Somasundaram.
iii. M. Mukundan.

High Jump:
i. M. Mukundan.
ii. P. M. Somanna.
iii. P. K. S. Mani.

Quarter Mile:
i. K. K. Menon.
ii. S. K. Sastry.
iii. M. Mukundan.

Cricket Ball Throw:
i. M. Mukundan
ii. P. M. Somanna.
iii. T. M. Kini.

Half a mile:
i. T. M. Kini.
ii. D. V. Rajagopal.
iii. Zainulabudeen.

Javelin Throw:
i. M. Mukundan.
ii. T. M. Kini.
iii. P. K. S. Mani.

Half Mile (Invitation):
i. Anthony Joseph (St. Michaels).
ii. Dominique (Government College).
iii. Ramanatha Rao (Union High School.

120 Hurdles:
i. K. K. Menon.
ii. T. M. Kini.
iii. M. Mukundan.

One Mile:
i. S. K. Sastry.
ii. T. M. Kini.
iii. D. V Rajagopal.

Obstacle Race:
i. T. P. S. Nainar.
ii. P. K. S. Mani.
iii. M. G. Rajaraman.

Intertutorial Tug of War:
Mr. C. Narasimha Iyengar's wards.

Intertutorial Relay Race:
Dr. J. S. Patel's wards.

Messages.

R. D. Anstead. On the occasion of the Diamond Jubilee of Agricultural Education in India, and the Silver Jubilee of the Madras Agricultural Students' Union I note with great pleasure that an old friend of mine will inaugurate the proceedings—Sir K. V. Reddy Garu. I have most pleasant memories of the work with him when he was Minister for Development, and I know how much his heart was in the work of the Agricultural Department, and how earnestly he had at heart the welfare of the ryots. That he is now officiating Governor gives me the greatest pleasure.

The history of Agricultural Education in the Madras Presidency and the part the Union have played in the Education, and of the Madras Agricultural Department is a thing to be proud of, and I feel sure that the future is bright, especially under the aegis of the present Viceroy, who as Chairman of the Agricultural Commission, had a unique opportunity of seeing the work of the Agricultural Departments of India.

As one who played his small part in the work of the Department and who has happy memories of that work and his colleagues I offer my most sincere congratulations and good wishes to you all.

* **Thomas Ramaswami Ramanujam.** *Voice Record.* "This is Great Britain Calling: The conquest of Nature by Science has made it possible for a voice to be heard from beyond the seas and to convey to the Jubilee gathering at Coimbatore, the greetings of fellow members of the Union now in Great Britain. Though exiled several thousand miles away, our hearts are one with you at this great epoch in the history of the Union. Besides wishing the Jubilee Celebrations every success, we send our hearty congratulations to all concerned on the very useful work the Union has done during a quarter of a century, and wish it a career of enhanced usefulness in the future."

Rao Bahadur Y. Ramachandra Rao. I wish to convey on this great and happy occasion my heartiest wishes for the well-being of the Union, and would pray to the Almighty to grant it long, long years of increasing and extensive usefulness to the cultivating public and the students past and present of the Agricultural College, Coimbatore.

Rao Bahadur C. Tadulingam, F. L. S. It gives me, one of the humble organisers of the Union, immense pleasure to note that His Excellency Sir K. V. Reddi Naidu, to whom the Department and the Union owe a deep debt of gratitude, has kindly consented to inaugurate the proceedings.

Wishing the Jubilee Celebrations, Conference and the College Day Sports every success.

K. M. Thomas. On behalf of the members of the Department now in England (Messrs. Ramaswamy, Ramanujam, Sankaran, Pillai and myself) I send our best greetings to our fellow members of the Union and colleagues in the Department. We wish the Jubilee Celebrations, the best of success and trust that what we have achieved in the past will goad us to launch a more ambitious programme for the future.

R. C. Broadfoot. I regret I cannot be present to share in the success of the Diamond Jubilee Conference, which I feel is assured. Anyway you have my very best wishes for the success of the functions during College Week.

Allan Carruth, O. B. E. This year the celebration of College Day has a special significance in that it is the Silver Jubilee of the Union. From small beginnings the Union has grown in strength and usefulness, and I see no reason why developments should not continue.

Greetings to all our members and best wishes for the success of College Day.

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* The voice record was played on the gramaphone on the opening day.

R. C. Wood. I wish you all success. It seems a long time to my Coimbatore days—after all it is a good many years, and I am getting nearer the time when I am due to retire, but I have very pleasant recollections of the time I spent there.

Telegraphic Messages were received from: Rao Bahadur B. V. Nath, P. H. Rama Reddy, Principal Lyalpur Agricultural College and others.

Messages were received from: Mr. K. Gopalakrishna Raju; The Vice Chancellor, Andhra University; Director of Agriculture Hyderabad State; Director of Agriculture, Bombay; and Mr. Kasiviswanatha Thampuran.

CULTURAL METHODS OF CONTROLLING PLANT DISEASES

BY RUDOLPH D. ANSTEAD, M.A., C. I. E.,

Retired Director of Agriculture, Madras Presidency.

Since the day, sixty years ago, when the Madras Agricultural Department was born, views on many agricultural problems have undergone a profound change. This is especially the case in those branches of the subject which deal with the pests and diseases of crops. During the past fifty years enormous strides have been made in medical knowledge of all kinds, including the health of plants.

An incessant war is carried on between man and insects, fungi, and bacteria, and many are the methods which have been recommended to combat these pests which take an enormous annual toll of our crops and stored products, and also of life of man and beast.

Despite this agricultural practices have been remarkably little influenced. It seems so obviously the right thing to ascertain the nature and life history of a pest and then to attack its weakest and most vulnerable phase. This, however, does not get to the real root of the problem, and in most cases is only a palliative. The hosts of the enemy remain, undiminished at their source, and the remedies have to be constantly applied. It is now being realised that direct attack by assault and battery is nearly always useless, and entomologists and mycologists are being rapidly transformed into plant pathologists, bringing these subjects into line with new developments of medical thought. A more insidious technique has begun to appear, which may be called perhaps the "cultural" method of preserving plants in health. The presence of the pest is ignored in this technique, and no direct attack is made on it.

In his Presidential Address to the Agricultural Section of the British Association at Toronto as long ago as 1924 Sir John Russell said: "these cultural methods of dealing with plant diseases and pests offer great possibilities, and the close study jointly by plant physiologists and pathologists of the response of the plant to its surroundings, and the relationships between the physiological conditions of the plant and the attack of the various parasites would

undoubtedly yield results of great value for the control of plant diseases."

Mycologists and Entomologists are turning their attention more and more to the effects of soil and climate on the incidence of disease, and it is now becoming generally recognised that there are vast possibilities of controlling many plant diseases, not by attacking the disease organisms themselves, but by controlling conditions in such a way that these organisms are unable to develop because they find the conditions imposed deleterious to them. Though the organisms are present they are unable to become effective because the conditions are not favourable to them.

For example, MacRae pointed out that foot rot (*Helminthosporium*) of Wheat in Northern India occurs only on early sown fields, and the remedy is not to spray, but to delay sowing until the cold weather sets in, and the temperature imposes conditions unfavourable to the development of the fungus. This is a purely "cultural" remedy based on a study of conditions which favour the crop and are unfavourable to the disease.

It is well known that a plant, or an animal, in good vigorous health is resistant to disease attack when subjected to infection. It is the plants or animals which are ill nourished and weak which fall easy victims. Hence the plant pathologist has in recent years turned his attention more and more to the study of the factors which maintain a plant or animal in vigour. When these are known it is often possible to provide for resistance when an epidemic of some sort, insect or fungoid, come along.

In 1924—25 the demonstration areas under cotton at Chendathur in the Fourth Circle were perfectly healthy, while all round the cotton on the ryots fields was attacked by " black arm " and looked as if a fire had been through them. All that had been done on our demonstration areas was to employ correct cultural methods. Dr. C. L. Withycombe dealing with the " frog hopper " pest of Sugarcane in the West Indies said that, " canes do not necessarily show serious " blight when fog-hoppers have been abundant, nor is an abundance of " the insect a necessary condition for serious blight ", and he maintained that the controlling factor was often the presence of plenty of water physiologically available to the canes, a factor which could be arranged for. Again, cotton leaf-spot (*Altenaria longipediciliata*) is a weak parasite able to infect weak tissue only under the most favourable circumstances, and yet in Trinidad when cotton is water-logged or has poor root growth it becomes a serious pest. (Empire Cotton Growing, Review. V. 1.48.)

Tunstall when reviewing Tea diseases and their remedies (Quar. Jour. Indian Tea Association 1920) puts cultural methods, such as

improved drainage, removal of excessive shade, and clean pruning, before direct methods like spraying, and work in Ceylon has shown that tea bushes which fail to recover after pruning and are attacked by *Diplodia* are really deficient in reserves of food. Wallace again, concludes that all the available evidence points to "leaf scorch", a frequent cause of loss to orchard growers, arises from defective nutrition and unsatisfactory water supply, cultural defects which can be remedied by drainage and manuring. (Jour. Pomology & Hort. Science VII 1 & 2.)

Rotation of crops will sometimes prevent disease attack. A case in point is the Betel Vine in the Madras Presidency which when grown continuously on the same land is apt to become infested with *Phytophthora* wilt disease, absent when rotation is practiced.

Eelworm attack on Sugar Beet and Potatoes is a danger. In Germany in 1876 this pest became so widespread that twenty-four sugar beet factories had to be closed down. The remedy lies in rotation of crop. Beet should only be grown once in four years on the same land.

Another method is that adopted by the plant breeder who, in many cases has been able to evolve new strains highly resistant to particular diseases so that the actual presence of insects or micro-organisms may be ignored. One of the latest examples of this method is the evolution of a "blast" (*Piricularia*) resistant strain of paddy at Coimbatore. Many other examples could be quoted. The strains of wheat resistant to rust produced at Cambridge by Sir R. H. Biffin are world famous, whilst varieties of potatoes resistant to virus diseases, and Poplar hybrids resistant to canker are well known.

An interesting example in this direction is the case of apple scab. At one time it was thought that this fungus pest could only be controlled by constant spraying, but experiments at the East Malling Research Station in Kent (England) have shown that certain rootstocks induce resistance, while others induce susceptibility to the disease. Hence it is possible to select rootstocks on which to graft apples which will help the grower to ward off the scab disease by a cultural method, and spraying is then unnecessary, or at any rate more effective. It is of interest to note that trees which were well manured benefitted from spraying more than trees on starved land. On the latter the disease is apt to be so bad that any control is impossible.

The internal condition of the food plant in relation to insect attack is of importance. The association of particular species of insects with particular food plants has resulted in an adaptation on the part of the insect with regard to the physiology of its digestion in a manner best suited to its requirements. Many insects fail to live on other than their normal food plants. The resistance or immunity of a plant to

insect attack is often due to factors closely associated with the physiology of the plant, probably the presence or absence of particular substances in the tissues of the plant. Thus Andrews showed that the vitality of *Helopeltis*, the " mosquito blight " of Tea is directly controlled by the suitability or otherwise of the food supply, and when a constant supply of soluble potash is applied to the roots of the tea bush it will remain immune from attacks for a long time.

Sugar Beet develops a specific disease in the absence of Boron: Oats suffer from a grey fleck disease in the absence of Manganese, though only one part in a million may be necessary to prevent this: Zinc appears to be essential for fruit trees which are otherwise attacked by rosette disease.

This leads to the question of vitamins which have been found to be so essential to the health of animals and man. Pioneer work carried out by the Madras Agricultural Department by Lt. Col. McCarrison, Viswanath, and others has indicated that there is a relationship between the supply of vitamins and the organic content of the soil, and has emphasised the importance of maintaining the humus content of soil. (Mem. Dept. of Agri. in India. Chem. Series. IX. 27. Indian Jour. Medical Research. IV. 4.)

The plant apparently obtains vitamins from the organic matter, possibly directly, and these vitamins are handed on to the animals which feed on them. The author would suggest that it is within the bounds of possibility that the vitamins are just as important to the health of the plant as they are to the health of the animals, and that it is not likely that the plant is merely acting as a transferring medium for these essentials of health. There is a growing mass of evidence to prove that when the humus content of the soil is allowed to run down below a certain level crops become increasingly subject to diseases of all kinds. Hence the importance of the use of organic fertilisers like Activated Composts.

Sir Albert Howard claims that in another fifty years time all plant diseases will be dealt with along such lines as have been here indicated, and that spraying machines and the like will only be found in museums. Though the author is not prepared to go quite so far as that, he does maintain that in the future more and more attention will be devoted in the campaign against plant pests and diseases to the cultural method of attack rather than to the shock attack of the sprayer, and he trusts that the Madras Agricultural Department, which he had the honour and privilege at one time to serve, will be found at the end of the next fifty years in the forefront of the battle in the same proud position which it has occupied since the day it was founded.

THE IMPROVEMENT OF INDIAN CATTLE

BY R. CECIL WOOD, M. A.,

Professor of Agriculture, Imperial College of Tropical Agriculture.

(Formerly Madras Agricultural Department.)

No excuse is needed for introducing the subject of the improvement of Indian cattle on the occasion of the Jubilee of the M. A. S. U., for not only are cattle of immense economic importance to the country, but in view of the exceptional position held by the cow in India, the subject is one that should be very close to the hearts of all. From the economic point of view, the ox is the foremost prime mover in the world, and is responsible for the tillage of a greater area than any other draft animal, nor does there seem reason to anticipate that this supremacy will be seriously challenged in the near future. The use of cow's milk is being more and more advocated by the medical authorities both for adults and children and as there is no satisfactory substitute, the demand for milk is limited only by the cost at which it can be produced.

With this realisation of the value of the cattle industry in India, it is suprising that so little attempt has been made to improve it. As far as the working ox is concerned, progress is negligible, and though the production of a better class of dairy animal has received rather more attention, it cannot be said, in view of the 150 million horned stock in the country, that this attention is adequate. As for the production of a dual-purpose animal, one in which the males will be good working animals and the females good milkers, no steps have been taken to improve the already existing breeds that display these characteristics.

There are two directions in which control in breeding, with a view to the improvement of stock, may be exercised: they are complementary to each other. Firstly, the prevention of the mating of inferior animals, and secondly, the encouragement of the mating of superior animals. It is not proposed to discuss the first of these here. It is necessary to say only that the way to prevent the spread of inferior germ-plasm is to isolate or to castrate all inferior male stock. Fencing would effect the first, but fencing in the Tropics presents peculiar difficulties. For the second, the practice of castration is by no means widespread, and when it is done, it is often done too late.

There is in India an objection to the early castration of an animal that looks as if it was likely to develop into a good working ox. It is held that the operation causes it to lose the masculine attributes of a heavy fore-part, so that the hump or shoulders which are desirable for exercising its full draught capacity are not fully developed. This

belief may or may not be well-founded, but it is surely time that some concerted effort was made to test this point, for it is one that affects every stock-owner in the country. If it could be shown that there is no justification for this belief, every effort should be made to educate the peasant to castrate the stock he does not want for breeding. That such a campaign would be effective, can be assumed from the success obtained in some of the African colonies where the number of animals thus treated, is increasing rapidly. Uganda, e. g. reports[1] in 1932, that 96% of the animals sent to the principal markets were castrated, whereas six years before, roughly this number were entire.

Turning to the other direction in which stock improvement must proceed, there is first the selection of the male stock to be used—for it is through the sire that improvement must start—and secondly the organisation of means whereby the services of such improved animals may be fully utilised. The first point, the selection of good male breeding stock is the one which presents the most uncertainty. There are two schools of thought, the one aiming at the improvement of the Indian animal (*Bos indicus*) by the use—to a greater or less extent—of imported bulls of the *Bos taurus* type, the other pinning their faith to the use of good bulls selected from the indigenous cattle.

What tropical experience is there on which we can draw in order to decide which of these two policies is the correct one? First, let us clear the air by pointing out that breediug single-purpose animals, either for work or for milk, implies two widely different objectives, and that a policy successful in producing one may not necessarily be good for the other. Secondly, it must be remembered that the Tropics is a wide term, and embraces not only the broad continents of Africa and India, where the seasons are marked, and where diseases may be rife, but also the islands of the Pacific and the West Indies, where seasonal variation is small and where many of the serious diseases of stock are unknown and unlikely to enter.

It will not take long to consider the improvement of the Indian working ox, for there has not, so far as the writer knows, ever been any question of improving him by crossing with *Bos taurus*. The primary requisites for such an animal are strength, courage and hardiness. "The animal to be produced is one that can live, breed and thrive most successfully under local conditions existing at the time"[2], and it is no good producing anything in advance of this. The efforts of the Veterinary Departments are improving conditions as far as liability to disease is concerned, in a most wonderful way, but beside the risk of disease, dreadful, but in the background, goes the ever-present fear of under-nourishment, or actual starvation.

If imported blood is not wanted, is there any evidence that success will result from the use of the best indigenous blood? Here we may safely fall back on the experience of other countries, where certain

recognised principles have been found successful in producing the type required, for there is no *a fortiori* reason why the adoption of these principles should not be equally successful in India. Actually, we can point, in S. India, to the carefully-bred herd of Mysore cattle, which are recognised on all hands to be greatly superior to the ordinary Mysore animal, and which have great reputation for work.

On the question of milk production it is less easy to dogmatise, for in both directions considerable success has been obtained. The standard of a dairy animal can broadly be recorded by a single figure, the number of units of milk yielded in a unit of time, and it is easy therefore to fix an "office-chair" standard, below which no animal will be accepted. The estimate of the quality of a working ox can only be made by watching and testing it at work, and must in the nature of things be largely personal. Continuity of policy is thus easy to obtain when breeding for milk, and *continuity of policy is essential.*

India shows us many examples of the success obtained in selecting for milk in indigenous herds. The Pusa herd, of Sanhiwal or Montgomery animals, gave an average yield of milk of 5·8 lbs. in 1913, and of 14·3 lbs. in 1928. Recent improvements in technique by Sayer[3], have recently still further improved on these figures. One cow—Chengi—at her second calving gave 6681 lbs. in 304 days in the last year under report. In Madras, the Department started in 1918 to build up a herd of 'Ongole' cattle starting with only 48 cows. The improvement in milk yield is shown below[4] :—

	Av. daily yield lbs.	Total.	Days dry.	Best Individual.
Foundation stock	9·8	2674	177	14·1
Present stock	11·5	3526	147	25·6

Figures that are more striking, perhaps because a larger number of animals have been under test, come from the Military Department Dairy at Ferozepore, the latest report on which states that "Twenty years' work......has resulted in a herd of Sanhiwal cows, with an overall annual yield of 8,000 lbs. of an average composition of 4% butter fat." The 1914 figures were an average of 5·9 lbs. of milk per head for the whole herd.

Such figures are satisfactory; progress has occurred, though to some it may seem slow, too slow indeed when the standard already reached by *B. taurus* in other countries is recalled. In England a cow called Terling Torch 46th, in her second lactation period, gave 30,000 lbs. in 320 days. Surely, urge the 'importing' school, surely the right thing to do is to utilise this dairy 'blood' in building up a dairy animal for the Tropics. And we find that this has been done to a considerable extent, and with no small measure of success.

Time does not permit of a thorough scrutiny of all these experiments, all that can be done is to summarise briefly the conclusions that can be drawn from them. It has been discovered that all breeds of *B. taurus** do not react in the same way, and it is most unfortunate that the breed first tried in India, and the one about which the greatest amount of information is available,—the Ayrshire—is one of the worst for this purpose. The Holstein or Friesian, on the other hand, seems to be remarkably suitable, and is very widely used today. Experience in Trinidad[5] with half-bred, three-quarter bred and even seven-eighth-bred Holstein-Zebu animals has been quite satisfactory. Experience in Jamaica[6] with Jerseys, Red Polls and Friesians, and in Fiji and Hawaii[7] and Puerto Rico[8] are similar. This seems fairly conclusive but Hammond[9] shows that *Bos taurus* in the Tropics almost inevitably suffers degeneration, though, in favourable circumstances the process may be a slow one. This degeneration is due to a number of causes, among which are the physical characteristics of unpigmented skins and unsuitable coat-covering, and the environmental conditions leading to poor feeding. This degeneration can be corrected by breeding back to *Bos. indicus*[10].

It is not denied therefore that in suitable conditions, with proper feeding, adequate housing, and under competent veterinary supervision, a satisfactory Dairy herd can be produced, composed of varying proportions of *B. indicus* and *B. taurus* blood. Such conditions are more likely to be found in the smaller islands of the Tropics, where quarantine can be effectively exercised, where imported foods can be cheaply landed, and where the climate is conducive to the production of grass all the year round. A brief description of conditions in Fiji may be quoted :— "The climate is equable: there are no epizootic diseases, no anthrax, no rinderpest, no foot-and-mouth, no tsetse and to ticks". Such conditions do not hold for India, and the writer feels strongly that in Madras the right line to take is the selection and improvement of the three excellent breeds that already exist, the Ongole, the Kangayam and the Mysore. If this is so, the sooner it is done is the better. Mention has been made of the start of the Ongole breeding scheme with less than fifty cows, when five hundred would not have been too many. What is wanted is the best cow in a thousand, and it should not be very expensive to test a thousand cows a year, selling those not up to the standard and buying others. Continuity in policy has been mentioned. It is mentioned again because without it progress is impossible and it has been singularly lacking in the past. Madras is fortunate in having had a single livestock officer for fifteen years; elsewhere constant change in personnel and in policy have proved a very great obstacle to progress.

* There were 20 different breeds listed at the Royal Ag. Soc. Show at Derby in 1933.

It is suggested therefore that the Madras Students' Union with its great opportunities of influencing public opinion might help on this work, the great utility of which it has been the object of this article to show.

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THE AGRICULTURAL DEPARTMENT *

The subject is one which must engage the attention of every one interested in the advancement of Agriculture in India. This advancement should proceed rapidly as long as the reins of Government are in the hands of our present Viceroy who has an intimate knowledge of the conditions of the agriculturists and the problems which confront improved agriculture. The report of the Royal Agricultural Commission which has considered all agricultural questions bears ample testimony to the attention which he has devoted even to details. India is behind several countries in Agriculture and it is hoped it will within the 5th year of His Excellency's Viceroyalty, rank among the foremost countries which can boast of improved and scientific agriculture.

Till 25 years ago, the Department of Agriculture was in the hands of a member of the Board of Revenue who had agriculture among his several portfolios. The agricultural college at Saidapet was more in name and it did not attract the best of the brains ; for the graduates turned out from the college could not expect appointments from Government as there were only few under the patronage of Government. A great impetus was given to the Department during the time of His Excellency Sir Arthur Lawley to whom we owe our present Agricultural College. Successive Directors of Agriculture, Mr. Anstead, Mr. Hilson, Mr. Ramamurthi, and successive governors of the Province have been improving the activities of the Department and

* *Speech delivered by*:—Rao Bahadur K. S. Venkatarama Iyer, Advocate and Mirasdar, Negapatam on the occasion of the 25th College Day and Conference.

now the applications for admission into the College are nearly ten times more than what the College could admit. There was a time when inducement had to be given by offering stipends; but now the stipends had been withdrawn and yet the college is increasing in popularity. The short courses in Agriculture, in the college, often suggested by me and introduced by Mr. Ramamurthi have been very popular and many a student from families of landholders have been benefited greatly and they are utilising their knowledge and experience to manage their own lands. This taste for practical agriculture has diverted many a wealthy young man back to his land from the idle, extravagant and expensive town life. There is an old proverb in Tamil "*கிராமத்தை வாங்கி காரியஸ்தனிடம் கொடுத்தான்.*"

This connotes the fact that the management was bad in the hands of the agents of absentee landholders and the agents had their own way of doing things.

There have been many friends of mine who remarked that Government farms were run on expensive lines and private landholders could not afford to spend so much. I had to convince them that the farms were Research Stations and were not run on commercial lines and that they were intended to give us the benefit of the research which were successful for a series of years. There are members of the Legislative Council who say the Department is a white elephant; but there are others who are practical agriculturists or those who have watched with interest the progress of the Department in its various activities. His Excellency Sir K V. Reddi, the Development Minister in 1921 used to congratulate me on my resolutions in the Council, most of which pertained to Agriculture. Though I am a small landholder, I gave up my lucrative profession of a lawyer and settled on my estate in the management of which I have burnt my fingers by trying to experiment but not without success in many instances. Let our landholders visit the Government Research Stations all over the Province and the Agricultural College; let them see and learn things first hand; let them adopt such of the strains and methods as would suit their lands and if 5 per cent. of the landholders would do so, real advancement would have been made and the endeavours of the Department could be said to have been crowned with success.

His Excellency the Viceroy has given practical proofs of his interest in Agricultural India by providing and maintaining at his own cost 2 stud bulls for use in Delhi District and the rough behaviour of one of them towards His Excellency's Private Secretary was a recommendation to keep him on longer.

His Excellency also pointed out that the Heads of Districts should be more in touch with rural areas and the Madras Government seriously considered the appointment of personal assistants to relieve Collectors of their routine work. This involves the expenditure on

salary of a high official. I am personally against this additional expenditure. The personal assistants are not more experienced or do not draw higher salary than Sub-Collectors and Divisional officers. The Divisional officers should be given more powers, and finality could be given to them in more matters. The Collectors and Divisional officers have been relieved of their income tax work; much of their magisterial work is looked after by first and second class benches. More retired officials and non official lowers can be appointed Special First and Second class Magistrates and Revenue officers can then find more time for agricultural work in rural areas.

The Collectors and Divisional officers whenever they camp in various places, may invite the landholders in the vicinity and they can find at least one or two educated and practical agriculturists who will help them in their rural work in giving practical advice to agriculturists. There is no necessity to appoint big committees or convene annual or bi-ennial conferences. It will be sufficient if a list of landholders who take a practical interest in agriculture is obtained from the agricultural department and informal conferences held with them in the presence of agricultural officers.

The formation of agricultural associations in which the revenue officers and subordinates should take an active part will go a great way. The endeavours of the Deputy Director of Agriculture, II Circle in this matter are really commendable. The Revenue Inspectors may be Ex-officio Secretaries of such associations instead of being Presidents and they alone can command the convenience and time, to convene meetings and bring up subjects for consideration. Non-official Presidents can be found easily to preside over the meeting. Details may be worked out by Committees of the Association to suit the local needs.

There may be Taluk Associations to which the Divisional Officer may be the President and Tahsildars Secretaries and the members of such associations may be nominated by the Divisional Officers on the recommendation of the Tahsildars or on application for memberships; election fighting need not be introduced in these associations. The members of committees may be nominated by the Divisional Officer. To start with, the members need not be asked to subscribe for memberships.

I have known many an assocation fail, because membership is saddled with subscription and it has been found difficult to collect even a nominal subscription of one anna a month. Government should allot small sums to the associations for contingent expenses such as printing and postage, till the associations are able to maintain themselves by voluntary subscriptions. Government should not decline small allotments for running the associations as they have done in the case of Irrigation Advisory Boards in the Province. I have been

a member and secretary of the Irrigation Advisory Board for more than 6 years and the sooner the Boards are abolished, the better it will be ; for, I believe no useful work can be done by them in spite of specific rules framed for their functioning as advisory bodies on which matters advice could be given. I am referring to their work merely to point out that the agricultural associations should not be merely advisory but should do practical work.

The Hon'ble Sir Charles Souter, who presided over the College day and conference last year rightly pointed out that the officers of the various departments should confer periodically with the revenue officers for help in their work and the District Heads have by our Viceroy now been officially entrusted with the task of agricultural propaganda and work.

The Imperial Council of Agricultural Research has been doing very useful work and thanks to the energy, intelligence and capacity of its Vice Chairman, Sir T. Vijiaraghavachariar, the Council has come to stay as a permanent institution and the Research Institute at Delhi under the very nose of the Viceroy is bound to tackle all problems calculated to give increased yield free from epidemics and diseases of plants.

Allied with Agriculture, is the Veterinary Branch of the Department of Government. The cattle wealth of India is a great asset to the country. The varied climatic conditions of India and the various breeds in different provinces are bound to improve the cattle wealth if only private landholders and private bodies will help Government in producing breeds for milk and for hard work. The Hosur Cattle farm which I had an opportunity to visit is doing useful work and it is hoped Government will allot more funds to enable the authorities to produce more pedigree bulls and cows. Since my visit, I got a bull for a friend, a heifer for another friend, and another heifer for myself. It need not be pointed out that the maintenance of a poor yielding cow is uneconomical and unsound, as the cost of maintenance is almost the same even for a good yielder, though the initial cost may be greater. In spite of departmental publications and bulletins, the ryot has no means of knowing simple remedies to save his cattle from epidemics. Small pamphlets bearing on cattle diseases, their remedies and how to prevent diseases should be published, in vernaculars and distributed widely. The touring veterinary assistant surgeons should stay for more than 2 or 3 days in important villages and disseminate practical veterinary knowledge in rural areas. The cruel mulling should be replaced by the new *Bordizzo* method of castration, which is painless and speedy. Landholders should be persuaded to castrate immature and worthless specimens of bulls in villages which otherwise would cover good cows.

The following are among the problems which must engage the attention of the associations:

1. Improved methods of cultivation.
2. Use of better strains suited to local conditions.
3. Fruit culture.
4. Bee-keeping.
5. Conservation of manure.
6. Raising of suitable crops to the particular areas.
7. Consolidation of holdings.
8. Maintenance of stud bulls.
9. Co-operative Stores.
10. Co-operative Trading Societies.
11. Marketing.
12. Reduction of Railway freights on manures and seeds.
13. Quick and cheap transfer of perishable articles and of fodder to long distances.
14. Issue of concession tickets to those who attend agricultural conferences and meetings of associations.
15. Redemption of agriculturists from their indebtedness, and other items too numerous to mention.

One more suggestion and I shall close my paper.

The Revenue officers and subordinates by virtue of their powers and influence, command respect in villages. The village officers are their subordinates. If those officers have training in agriculture, they will naturally have interest in agricultural work in rural areas. This can be possible only if agricultural graduates are taken in the service of the revenue department. The Agricultural graduates have had sufficient arts course, to enable them to look after clerical and other duties which are at present entrusted to Arts graduates. If at least 50 per cent, of the recruits to the revenue department are recruited from agricultural graduates and gradually absorbed in the revenue department, the rural agricultural work can be easily done by such Revenue Subordinates and without much effort or inducement, practical agricultural work in rural areas will spread. The Agricultural graduates who are recruited to the Revenue Department should also be given practical training in co-operation for a period of 3 months at least, to enable them to supervise the work of rural co-operative societies in their tour. If that is done, some of the large number of Arts graduates turned out will not pester the Revenue officers for appointments, but will be diverted to the Agricultural college as they can be sure of appointments in the Revenue Department.

However much Government might encourage agriculture in rural areas, their endeavours can never be a success, unless the agriculturist in the village is content, free from debts and able to get enough income for the maintenance of himself and his family. The rules of the

Primary Land mortgage banks which are supposed to give relief to indebted agriculturists are not workable in practice and are liable to be misused. Government should step in to redeem the agriculturists by paying their debts and getting the loan back in easy instalments with cheap interest. The landholders are becoming more indebted year after year and the lands are passing into the hands of money lenders who are absentee landholders. Unless the owners of the land in the villages are enabled to hold their lands with the prospect of owning them free of liability in the course of some years, the very useful work turned out by the agricultural department will be undone and the slow and steady improvement in agricultural methods will gradually deteriorate in the hands of absentee landholders who will wait for an opportunity to get rid of the land and the interim lessees who will be interested only to get whatever is possible from the lands, will have no interest in maintaining the fertility of the lands to enable continued better yield. It must be the duty of Government to take early measures for the redemption of agriculturists from their debts and there is no use adopting measures drastically and in a small scale here and there as experimental measures and if Government should delay awaiting the result of their experiments, the remedy will be too late and it will be only shutting the stable after the horse is stolen.

I will also suggest the desirability of publishing suitable agricultural primers for use in Elementary Schools and including the teaching of agricultural subjects for at least 2 or 3 periods in a week. It will create an aptitude and a taste for agriculture in the early days of the boys and it may happen that agriculturally inclined boys may develop a taste in agriculture in their later life. If Government is inclined to agree with my view, a small committee of agricultural experts of the college including retired agricultural professors and one or two non-officials may be entrusted with the work of writing books in easy colloquial style and I shall be glad to serve on that Committee.

If Government do not decide to adopt my suggestions, I shall be willing to write and publish primers for elementary schools provided Government will introduce such books in all Elementary schools if my publication will command the approval of the Agricultural Experts.

I do not wish to take more of your valuable time and I will close after touching on the question of finance which is put forward as the ground for not allotting more funds to the Agricultural Department.

The village officers clamour for more pay and I do not go into question if their clamour is justifiable in the face of the perquisites they enjoy from time immemorial; but to maintain four village menials at a cost of more than Rs. 30 for each village is most unreasonable. There used to be one or two to each village. Each village menial was getting only Rs. 4 formerly. Their number and pay have been unnecessarily increased. There is absolutely no work for four. A careful enquiry will reveal the fact that their time is spent more on private

work rather than on public work. A retrenchment under this head which will be a very proper one, will yield at least Rs. 35,000 for each district and more than 6 lakhs for the whole of the presidency, not a negligible item. There are more items under which retrenchment can be effected; but if committees for retrenchment are appointed all the members cannot be expected to be above being influenced by particular officers and the labour of such committees will be fruitless and no tangible reduction will be possible. One hard financier must be put on special duty and he must invite suggestions from officials and non-officials and report after investigation.

Correspondence.

Note :— A further reply from Mr. P N. Krishna Iyer has been received regarding the controversy about the host plants of *Pempheres affinis*. A note to the effect that "further correspondence on this subject will cease" had been sent by the Editor for publication in the July issue but unfortunately this had been, by oversight, omitted in the final proof stage. It is not proposed to publish any more correspondence on the subject in the journal. — *Editor*.

Review.

The Cultivated Races of Sorghum. J. D. Snowden Adlard & Son., Ltd., London. 1936. 10 s. 6 d. Sorghum is an important cereal. It is the staple food crop of the poor in many parts of the world. In the British Empire its importance to the indigenous population is obvious. With rich and bulky fodder, we have in it a crop pre-eminently suited to the needs of both man and beast; and its improvement is thus naturally engaging the attention of many Economic Botanists in the British Empire and in the world. In America work on sorghum is much advanced as it is the crop that occupies areas not quite suited to maize. It is, therefore, no wonder that with the appointment of Mr. H. C. Sampson (the late Director of Agriculture, Madras) as Economic Botanist, Kew, his interest in economic botany found its first expression in this desire to increase the knowledge on this important crop. Knowledge is power and the power to handle a crop is the measure of its useful handling. The usual canons of classifying wild plants receive a serious setback when it is a question of dealing with a cultivated one. The difficulties increase, when, as in the case of sorghum, it is a case of reconciliation with much valuable previous work, done at many centres of Europe by nations interested in their colonial dependencies.

The first comprehensive account of the Races of Cultivated Sorghum is thus available in this valuable work by Snowden. As the retired Economic Botanist of the Uganda Protectorate he is familiar with the plant in the field and has come to his task with an intimacy of touch that makes his classification alive and real.

In addition to the very detailed systematic work, Mr. Snowden has contributed a historical study of sorghum from literature. He has also elucidated many obscure points in its botany. This work is thus a landmark in the knowledge concerning sorghum. It is hoped that with this equipment the many sorghum workers in the empire and the world will go ahead with accounts of the sorghums in their respective regions and thus complete our knowledge of the sorghums of the world.

The Trustees of the Bentham Moxon Fund are to be congratulated on their warm response to the request of Kew to finance this very valuable publication and in securing so able and experienced an Economic Botanist as Mr. Snowden to work at it.

G. N. R.

Crop & Trade Reports.

Receipts of raw cotton at presses and spinning mills.

Loose cotton.

	Bales of 400 lbs. against an estimate of 540,700 bales for 1935—36.	Figures for corresponding period in previous year.
1—2—36 to 19—6—36	306,807	271,357
,, 26—6—36	330,364	284,966
,, 3—7—36	352,099	296,418
,, 10—7—36		
,, 17—7—36	400,366	322,160
,, 24—7—36	422,549	334,131
,, 31—7—36	439,111	344,026
,, 7—8—36	456,152	352,220
,, 14—8—36	467,021	353,687

Pressed Cotton.

	Receipt in mills.	Export by sea	Import by sea.
1—2—36 to 19—6—36	197,424	84,043	73,511
,, 26—6—36	217,695	91,147	73,875
,, 3—6—36	225,561	95,133	74,428
,, 10—7—36			
,, 17—7—36	245,924	113,784	74,926
,, 24—7—36	257,319	127,772	74,926
,, 31—7—36	269,449	141,247	75,110
,, 7—8—36	278,168	153,578	75,162
,, 14—8—36	284,475	156,756	90,677

Cotton—1936—37 first forecast report. The average of the areas under cotton in the Madras Presidency during the five years ending 1934—35 has represented 9 per cent of the total area under cotton in India.

The area under cotton up to the 25th July 1936 is estimated at 286,300 acres. When compared with the area of 301,400 acres estimated for the corresponding period of last year, it reveals a decrease of five per cent.

Central Districts and South—Mainly Cambodia tract. The area in the Central districts and the South represents generally the last year's crop left on the ground for second pickings before the plants are removed in September in compliance with the provisions of the Pest Act. The area in these districts fell from 186,000 acres to 161,200 acres i e. by about 13·3 per cent. The decrease is marked in Coimbatore, Madura and Ramnad. The yield is expected to be generally fair.

Westerns Tract. The area under Westerns rose from 75,800 acres to 81,500 acres. The increase is marked in Anantapur owing to the favourable season.

Cocanadas tract. The area under Cocanadas cotton rose from 9,700 acres to 15,100 acres. The increase is marked in Guntur.

The wholesale price of cotton lint per imperial maund of 82-2/7 lbs., as reported from important markets towards the close of July 1936 was about Rs. 19—9—0 for Cocanadas, Rs 25—11—0 for red northerns, Rs. 19—1—0 for westerns, Rs. 25—4—0 for Cambodia, Rs. 24—3—0 for Coimbatore—Karunganni, Rs. 23 for Tinnevelly Karunganni, Rs. 23—14—0 for Tinnevellies and Rs. 20—6—0 for Nadam cotton.

Sugarcane 1936—37. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1934—35 has represented 3·6 per cent of the total area under sugarcane in India.

The area under sugarcane up to the 25th July 1936 is estimated at 98,950 acres. When compared with the area of 97,050 acres estimated for the corresponding period of last year, it reveals an increase of about two per cent. There has been an increase in area in West Godavari, Guntur, the Deccan, Nellore, Chingleput, Chittoor, North Arcot, Tanjore, Tinnevelly and South Kanara, which has been partly counterbalanced by a decrease in area in Vizagapatam, Kistna, South Arcot, Salem, Coimbatore, Trichinopoly, Madura, Ramnad and Malabar. The large increase in area in Bellary is attributed to the working of the sugar factory at Hospet while the increase in North Arcot is due to the favourable season.

The condition of the crop is generally satisfactory.

The wholesale price of jaggery per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of July 1936 was Rs. 6—9—0 in Adoni, Rs. 6—3—0 in Madura, Rs. 5—9—0 in Nandyal, Rs. 4-15—0 in Bezwada and Kumbakonam, Rs. 4—12—0 in Guntur and Tuticorin, Rs. 4—10—0 in Masulipatam, Rs. 4-7-0 in Calicut and Mangalore, Rs. 4-6-0 in Ellore and Mangalore. Rs. 4-6-0 in Ellore, Rs. 4—5—0 in Rajahmundry, Rs. 4—2—0 in Bellary, Cuddapah and Coimbatore, Rs. 3—15—0 in Cocanada, Rs. 3—10—0 in Vellore, Rs. 3—9—0 in Salem, Rs. 3—3—0 in Vizagapatam and Rs. 2—15—0 in Trichinopoly. When compared with the prices in the corresponding period of last year, these prices reveal a fall of 37 per cent. in Bellary, 34 per cent. in Trichinopoly, 31 per cent. in Nandyal and Vellore, 30 per cent. in Vizagapatam and Cocanada, 28 per cent. in Cuddapah, 27 per cent. in Ellore, 22 per cent. in Rajahmundry, 21 per cent. in Bezwada and 20 per cent. in Guntur and Coimbatore.

Gingelly.—1936—37.—First Rport. The average of the areas under gingelly in the Madras Presidency during the five years ending 1934—35 has represented 11·6 per cent. of the total area under Gingelly in India.

Area. The area under gingelly up to the 25th July 1936 is estimated at 344,700 acres. When compared with the area of 279,900 acres estimated for the corresponding period of last year, it reveals an increase of 64,800 acres, i.e about 23 per cent. The increase in area occurs in all districts except Kistna, Nellore, Salem, Trichinopoly, Ramnad, Tinnevelly, and South Kanara.

Yield. The yield is expected to be below normal in Vizagapatam, East Godavari, West Godavari, Bellary, Anantapur, Trichinopoly, Tanjore and Madura, and normal in the other districts.

Groundnut—1936—Second report. *Summer crop—Area and yield.* The area under the summer or irrigated crop of groundnut in parts of the Madras Presidency during the five months—January to May 1936—is estimated at 61,300 acres. When compared with the area of 67,000 acres estimated for the corresponding period of last year, it reveals a decrease of 8·5 per cent. The crop has been harvested in most places. The yield is reported to be normal. The total yield is estimated at 54,900 tons of unshelled nuts as against 57,000 tons during the corresponding period of last year.

Early Crop—Area and yield. The area under the early crop of groundnut (mostly unirrigated) up to the 25th July 1936 in the districts of Salem and Coimbatore, is estimated at 128,000 acres. When compared with the area of 96,000 acres estimated for the corresponding period of last year, it reveals an increase of 33 per cent. The condition of the crop is satisfactory. The total yield is estimated at 64,000 tons of unshelled nuts as against 44,100 tons estimated for the corresponding period of last year.

The wholesale price of groundnut (shelled) per imperial maund of 82-2/7 lb. as reported from important markets towards the close of July 1936 was Rs. 7-1-0

in Cuddalore, Rs. 5—4—0 in Vizagapatam and Negapatam, Rs. 6—1—0 in Vizianagaram, Rs 6—0—0 in Vellore, Rs. 5—14—0 in Guntur, Rs. 5—13—0 in Cuddapah, Rs. 5—11—0 in Cocanada and Salem, Rs. 5—8—0 in Adoni Rs. 5—7—0 in Nandyal, Rs. 4—6—0 in Madura. Rs. 4—3—0 in Ellore and Rs. 3—6—0 in Tinnevelly. When compared with the prices of June 1936. these prices reveal a rise of 16 per cent. in Adoni, 11 per cent. in Negapatam, 6 per cent. in Cuddalore, 5 per cent. in Vellore, 4 per cent in Cuddapah, 3 per cent in Cocanada and 2 per cent in Vizagapatam, Vizianagaram, Ellore and Salem, and a fall of 7 per cent. in Madura. The prices remained stationary in Guntur, Nandyal and Tinnevelly.

College News & Notes.

The Students' Club. Mr. Chen of Nanking delivered an interesting lecture on "Boxing in China". On 17—8—'36 the inagural address of the Students' Club was delivered by Dewan Bahadur T. A. Ramalingam Chettiar, M. L. C. Rao Bahadur G. N. Rangaswamy Ayyangar presided over the function.

Association of Economic Biologists. Under the auspices of the Association Mr. Chen of Nanking delivered an impressive lecture on the "present problems of cotton improvement in China".

Visitors. On the occasion of the Jubilee Celebrations and College Day, the Pudukotta Durbar deputed several of their Agricultural subordinates to attend the functions.

Weather Review (JULY 1936).

Summary of General Weather Conditions. The monsoon was generally active throughout the month on the West Coast and in the Circars, and particularly so in the latter regions.

Two depressions influenced the weather in the Bay of Bengal. The first depression formed off the Orissa—Ganjam Coast on the 2nd and passing inland near Balagore on the next day lay over Chota Nagpore till the 5th as a shallow depression and then filled up. The second depression also formed off the Orissa—Ganjam Coast. on the 21st and after intensifying into a storm crossed the Coast between Gopalpore and Puri on the 24th and passed into East Central Provinces on the 25th and filled up over Bihar by the 26th. Both these depressions occasioned heavy rainfall in South Orissa and Ganjam.

The month's rainfall was markedly above the average in Ganjam and South Canara, in defect in the Ceded Districts and was nearly normal elsewhere.

The chief falls reported were, Icchapur 9·5, Gopalpore 7·9, Nowrangpur 7·5 and Parlakimidy 6·5 and Berhampore 5·6 on the 23rd and Gopalpore 5·1 on the 25th.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	21·3	+14·4	50·1
	Berhampore*	15·6	+7·2	36·5
	Calingapatam	14·3	+9·0	25·4
	Vizagapatam	3·3	-1·2	15·6
	Anakapalli*	4·0	-1·61	22·5
	Samalkota*	9·7	+2·2	30·3
	Maruteru*	10·0	+0·6	25·0
	Cocanada	7·4	+1·6	25·0
	Masulipatam	10·4	+4·0	25·4
	Guntur*	7·1	+1·4	24·9
Ceded Dists.	Kurnool	3·0	-1·8	10·4
	Nandyal*	5·3	-0·1	13·9
	Hagari*	0·8	-1·2	6·6
	Bellary	0·2	-1·7	3·2
	Anantapur	0·5	-2·9	5·6
	Rentachintala	4·9	—	11·4
	Cuddapah	3·0	-0·9	8·2
	Anantharajupet*	2·3	—	—
Carnatic	Nellore	4·1	+1·3	7·6
	Madras	4·9	+1·0	11·7
	Palur*	4·1	+1·8	12·8
	Tindivanam*	3·6	+1·9	10·4
	Cuddalore	1·9	-1·2	9·2
Central	Vellore	1·8	-3·5	8·3
	Salem	4·7	+0·9	20·6
	Coimbatore	2·2	+0·7	9·7
	Coimbatore Res. Inst.*	2·0	+0·7	9·3
	Trichinopoly	3·2	+1·6	12·1

Division	Station	Actual for month	Departure from normal @	Total since January 1st
South	Negapatam	3·2	+1·3	13·6
	Aduthurai*	4·7	+3·5	12·1
	Madura	3·8	+1·9	13·0
	Pamban	0·2	-0·4	5·5
	Koilpatti*	0·1	-0·6	8·9
	Palamkottah	0·2	-0·2	12·2
West Coast	Trivandrum	8·3	+0·9	41·3
	Cochin	20·0	-2·8	73·3
	Calicut	33·9	+3·7	93·7
	Pattambi*	29·3	+5·0	70·9
	Taliparamba*	41·0	-4·6	86·0
	Kasargode*	53·7	+16·4	112·0
	Nileshwar*	50·5	+10·8	98·7
	Mangalore	46·9	+9·8	105·8
Mysore and Coorg	Chitaldrug	—	-3·1	6·3
	Bangalore	5·6	+1·4	15·8
	Mysore	3·8	+1·1	19·3
	Mercara	50·6	+9·7	103·4
Hills.	Kodaikanal	6·1	+1·1	24·8
	Coonoor*	4·3	—	35·1
	Ootacamund*	7·3	+1·7	30·8
	Nanjanad*	5·4	-5·9	31·7

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Weather Report for the Research Institute Observatory:—

Report No. 7/36.

Absolute maximum in shade	...	90·5°F.
Absolute minimum in shade	...	68·3°F.
Mean maximum in shade ...	...	86·1°F.
Departure from normal ...	...	-1·0°F.
Mean minimum in shade ...	...	71·1°F.
Departure from normal ...	...	-0·9°F.
Total Rainfall for the month	...	1·95″
Departure from normal ...	...	+0·68″
Heaviest fall in 24 hours ...	...	0·66″ (Recorded on 1-7-1936).
Total number of Rainy days	...	5 days.
Mean daily wind velocity	...	5·6 M. P. H.
Mean Humidity at 8 hours	...	72·1%
Departure from normal ...	...	+0·7.

Summary. The monsoon was generally active and the rainfall was above the average, other climatic elements were not far from normal. P. V. R. & D. V. K.

H. E. Sir KURMA VENKATAREDDY NAIDU GARU Kt.,
Officiating Governor of Madras who inaugurated the Jubilee Proceedings.

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Editorial.

Soil Conservation. Soil conservation was one of the subjects discussed by the Board of Agriculture at its meeting held at Delhi in March last year. The Board, while approving of the progress made in the provinces since their consideration of this topic in 1916, recommended that greater attention should be paid to the practical application of the knowledge already gained and that works similar to those tried in Bombay should be commenced in other provinces. We find in the note sent by the Deputy Director, Southern division, Bombay, to the Board on the experiences gained there that the Agricultural department appointed at first a graduate assistant and later on two bunding officers to design embankments and waste weirs, to advise the cultivators with regard to their location and construction and also to help them in the securing of the *takavi* loans from the District collectors. We are sorry to notice however that the beneficial effects which these officers brought about came to a stand-still when their posts were retrenched on grounds of financial stringency and when the interest on the loans was also increased to 8·3%. While even such small lines of work are being stopped as a result of retrenchment in India, we find other couutries like the United States of America, Japan, Italy, Java and even the much war-disturbed China,

recognise the importance of soil erosion and the associated problems to the nation and are taking concentrated action on a wide front. An action like the one on the part of the Bombay Government would make one believe that there is perhaps not much need or scope for the adoption of preventive measures in this country. That this is not so is apparent from a few instances given below.

The silting of tanks classified in the Government accounts as first class sources of irrigation and yet unable to supply water for the prescribed period, the choking up of important and costly dams, the general rise in the beds of rivers with the loss of many of their valuable spring channels, and the conversion of fertile lands into mere sandy flats are some of the results of soil erosion. We may also add that the frequent cry now raised by the cultivator that their crop-yields have declined considerably is to a certain extent a consequence of the perpetual drain on their most valuable capital—soil—which cannot be replaced by any system of cultivation or manuring. We, therefore, consider that the recommendations of the Board of Agriculture have come none too early in the day.

In Madras, the problem of soil erosion and conservation has, until very recently, received little consideration. The more destructive and insidious sheet erosion is allowed to work havoc especially in the vast black soil regions. Owing to the general depression and the consequent increase in the debts, many of the land-owning cultivators have perforce been changed into tenants with the result that their interest in the land has abated considerably. The new land-lords, being mostly absentee owners, not only do not recognise the fact that their newly acquired assets are being undermined but also go on changing the tenants every year without paying any attention to the maintenance of soil fertility. We are afraid that unless early steps are taken to control this evil, many a field which is now cropped may have to go out of cultivation. We are inclined to believe that some of the items of improvements recommended by the agricultural department particularly the advocacy of summer ploughing of the lands stand the risk of losing their value without the concomittant problem of soil erosion being tackled simultaneously.

To us it appears, therefore, essential that no time should be lost to warn the cultivator of this silent enemy and to help him in all ways to fight it by the timely adoption of suitable preventive methods. If necessary the agricultural department may be armed in view of the importance of the problem in a number of tracts with adequate legislative measures to bring recalcitrant ryots into line with others. Even in a democratic country like the United States of America a soil conservation service was brought into existence in 1933 as a temporary measure which was made permanent by an act in 1935. This body has been empowered to conduct surveys and researches, to carry out

preventive measures, to co-operate or enter ito agreements with, or to furnish financial aid to, any agency, government or otherwise, and to purchase rights or lands if necessary for the proper functioning of the act. It is reported that as a result of establishment of this agency many thousands of acres of abandoned or about to be abandoned lands have been brought back to cultivation.

We would suggest that the subject of soil conservation may be placed in the fore-front in the agenda of work of the newly constituted district economic councils, and district agricultural associations in tracts where the problem is acute. Ways and means can be sought gradually to bring into action the results of experiences gained in other provinces as well as those obtained from the experiments that have been going on at the dry farming station, Hagari. We venture to suggest that the subject of soil conservation will be a suitable one to receive a moiety of the fifteen lacs of rupees now allotted to this province for the rural development by the Government of India. We also feel that the present moment when plenty of money is lying idle in the banks and when huge Government loans are over-subscribed in a few minutes, can be taken advantage of to float a loan at a low rate of interest to re-inforce the slender resources of the back-bone of the nation -the ryots—for purposes which are certain to return decent profits in the long run both to the creditor and the borrower. Incidentally any special works undertaken in this connection might not only go to relieve unemployment to a certain extent but also facilitate monetary expansion. Concurrently the existing rules of the land improvement act may be examined whether they can be modified to suit the measures undertaken towards soil conservation. The villagers will have to be first educated by means of posters and leaflets and convinced of the necessity of their co-operation and earnest joint action in the matter.

This problem of soil conservation will also be a fit subject for the joint action of the Engineering and Agricultural departments to start experiments for the determination of cheap and efficient methods of control suited to the various tracts. We are glad to note in this connection that some action along these lines has already been taken by the agricultural department in the Bellary district (vide an article in last November issue of our journal). We confidently hope that similar steps will be taken in other districts like North Arcot, South Arcot, Salem, Tinnevelly, Guntur, Kurnool, and Nilgiris, where the problem is equally serious.

AGRICULTURAL PROPAGANDA.

BY

N. S. KULANDAISWAMI PILLAI.

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Introduction. Of all the provinces in India, Madras is mainly agricultural. The total population of the Madras Presidency is estimated at 48·64 millions in 1935 of which 71 % live by agriculture. An analysis of the population living by agriculture reveals that 43 % form agricultural labourers, 39 % cultivating owners, 12 % cultivating tenants, 3½ % non-cultivating owners and 1½ % non-cultivating tenants.

The total area under cultivation is about 34 million acres which works out to less than 0·75 of an acre per head of population. Thus the pressure of population on the soil is very great. It has increased since 1914—15 when it was estimated to be just under 1 acre per head.

This large population depending on agriculture is scattered over innumerable villages, the majority of which are accessible only to slow moving country carts even in the best of weather conditions. When rains set in, a still greater number become inaccessible to all except pedestrians.

The villagers themselves are poor, uneducated, ignorant, superstitious, heavily indebted and with a low standard of life. The enervating climate, the treacherous seasons, the social and religious customs, the scattered, sub-divided and uneconomic holdings, lack of capital and the poor cattle, all tend to retard the development of agriculture in the country and make it a losing business concern.

Of late the ryot is awakening to a sense of his position. This is the silver lining to the clouded sky ; for, this will lead to his redemption in a measurable distance of time.

It is to bring the resources of science to bear upon agricultural problems and spread the knowledge obtained thereby to the ryots and thus better their lot, that agricultural departments were established in India. Prior to 1905 there were no organised attempts at agricultural improvements by Government. Since then they are increasingly recognising their responsibilities in the matter and are taking steps to discharge them.

Greater and greater attention is being paid to agricultural research. Without research, agricultural development will be at a stand-still. When research attains a certain stage, propaganda should be simultaneously carried on to spread that knowledge to the farmers. Propaganda forms therefore a complement to agricultural research; without propaganda, research will be of little use.

In the early days of the department when there were only a few workers and research was just in its infancy, there was not

much scope for propaganda. The work of the department as described by Mr. James Mackenna may be summarised as follows:—

"The Problem which the department sets itself is the improvement of Indian agriculture. The basis of all progress is research. The results of research are then tested on a field scale. When the experiment is proved, the stage of demonstration is reached. All the experimental work must be done by the Department and its results offered for application in a cheap and simple way.

It is obvious that if results of a practical value are to be obtained the agricultural worker must have a thorough knowledge of Indian Agriculture and sympathetic feeling towards the people. Above all he must *go slow*".

He realised that "to influence to any extent the vast agriculture some arrangement must be devised to deal with large bodies of cultivators as it is an economy of time to deal with a group of people rather than to deal with single individuals". He expected this to be carried out through the simultaneous development of the Co-operative movement.

After the lapse of more than 2 decades most of these expectations remain yet to be realised. After all these years of travail, even the credit movement, which is considered to have succeeded most, has not touched more than 6% of the population.

We have now come to a stage when we have some data which will help the farmer if he is made to understand them and induced to take them up. We have tried our best to make the fullest use of the co-operative movement to do our propaganda work. Standing on this same platform nearly a decade ago, I narrated how my attempts to induce members of co-operative credit societies to adopt improved methods of agriculture failed and how I started special co-operative societies with the object of spreading improved methods of agriculture and explained the progrees then made by them. I then expected them to progress considerably better than they have done so far and hoped to start and run successfully more such societies. The unfavourable season for a number of years, the economic depression and above all want of incentive stood in the way of further development along that line.

To overcome these difficulties I started village, firka, taluk and district agricultural associations. Many of these are now moribund. They do not rest on self-help. Hence they do not function if the demonstrator is unable to look after every detail of their working. The intensive drive of mass propaganda inaugurated by our former director, Mr. S. V. Ramamurthy gives the demonstrators no time now to attend to such details of work. I am yet to hear that any similar movement has succeeded anywhere on a large scale in this Presidency.

Under such circumstances the traditional method of tackling individual ryots by the Department is more the rule than the exception. This is very laborious and still is in the nature of ploughing the sands. As one who has himself been a demonstrator, I know the difficulties experienced in carrying on the work along the present lines. The demonstrator with great difficulty has to pitch upon a few

ryots in a village to try the improvements recommended by the Department. When he visits the village next he hears that one of them has gone to a neighbouring village, the whereabouts of another are not known, a third is busy otherwise and so on and so forth. A few go on eternally discussing the improvements suggested, but never agree to work out even one of them practically for trial. Hours, days and months are thus spent by the demonstrator without any appreciable effect. I often doubt if even centuries of ill directed efforts like these will ever bring about the desired improvements. The concentration method adopted during recent years which has prevented the demonstrator from wandering aimlessly through-out his jurisdiction is just a step further in the right direction; but it will not take us far. Attending 8 to 10 centres involving 40 to 50 villages is a task beyond the capacity of a single demonstrator. In deltaic areas and on the banks of rivers the villages are close together and their total area is small, while in other tracts the villages are far apart and large areas have to be dealt with. This is due to the fact that Government has based the size of villages and taluks on the amount of revenue fetched by them. In such cases it is desirable that, in addition to the demonstrator at the taluk head quarters, every Deputy Tahsildar's division is provided with an additional demonstrator, and each demonstrator is assisted by an adequate staff of maistries. Above all, there should be some organised bodies to help the demonstrator in his propaganda work.

A former Director of Agriculture in France pointed out the difficulty of dealing with individual farmers in the following words:—

"It is impossible for a Government to influence millions of petty peasants; they are individually too isolated, too suspicious, too shy to accept new ideas to undertake experiments in new methods; similarly they are too poor, too powerless to produce the best products to get better of the middlemen, and the best of the markets".

He pointed out that "there must be some organisation which enables Government to act upon a body of men at once and to serve as intermediary between the Government and the individual. An organisation which can be advised, educated, reasoned with, and listened to, and which will discuss together the suggestions of authority and will through its better educated and bolder members—provide intelligence to absorb new ideas, find courage and funds to attempt new methods and combine both for the improvement of products and for the better sale of the same."

Realising as we do the serious drawbacks of dealing with individual ryots it is incumbent upon us to discover fresh avenues which will result in leading us to better success.

A study of the methods successfully adopted by other people placed under similar circumstances may perhaps give us clues for solving our own problems; for human nature is the same all the world over.

The Japanese for example have solved their agricultural problem by imparting education, both general and agricultural, and also by the

establishment of various types of agricultural associations. In his note on agriculture in Japan, Sir F. A. Nicholson observes, that "the development of general education has been at the root of much of the national progress and has affected and will in the near future most powerfully affect the progress both of the technique of agriculture and the agriculturist."

Higher Elementary schools with an agricultural bias, supplementary schools to supplement the work of the elementary schools, regular agricultural schools of lower and higher grades and agricultural Colleges lead the boys from one stage to another according to their capacity, wealth etc. There are thousands of such institutions spread throughout the length and breadth of the country and thousands of pupils are trained in them.

Writing about agricultural associations the same author observed—"these are among the most remarkable evidences and are becoming most powerful instruments of agricultural progress in the country. Practically the whole agricultural population of Japan is united in various forms of associations; probably there is no country in the world, not even Germany, where the associations have taken such hold and are beginning to exert such influence".

All these were prior to 1906. During the succeeding three decades the great strides made by this country in developing its agriculture, have converted it from a food importing country to a food exporting country, in spite of the rapid increase in its population.

The Rural Districts of Denmark as late as 1880—90 had been in a bad way and the people were leaving the country parts for the towns. At the present time all authorities bear witness to the general well-being and contentment of rural Denmark. A three fold development was at the root of the progress—(1) economic reforms, (2) machinery for rural development and (3) technical advance on scientific lines. The economic reforms have been conducive to the formation and maintenance of small farms and state laws have been in the interests of the small farmers who now form their country's pride. The machinery for rural development consists of arrangements for rural and agricultural education and co-operation. Both agricultural schools and co-operative societies were started as private ventures. Scientific dairying has been fully developed on modern lines.

Coming nearer home to the premier state of Mysore it may be noted that it passed a village Panchayat Act during 1926 and gave effect to it in 1927. "The Act recognized the backwardness and the diseased state of social conditions in rural areas and felt that unless some external support and schooling were given, the Village Panchayat may not come to possess local foundations at all". Now the Village Panchayats have some obligatory functions like village communication, sanitation and also certain discretionary duties such as vaccination

economic improvement and delegated duties including the control of the village-forests, tanks, and local religious institutions. The responsibility of supervising the working of the Panchayats is vested in the executive head of the district who is assisted by Inspectors of Panchayats, and the whole system is co-ordinated and controlled by the Registrar of Panchayats.

From a recent notification of the Government of Mysore which appeared in the Hindu of May 12th, it is found that an intensive programme of Rural Re-construction is being taken up through the Village Panchayats. More than 11,000 Village Panchayats have been constituted to administer local affairs in rural areas. The progress achieved during the 9 years the act has worked, is remarkable. More than 30 per cent of the Panchayats are said to function very efficiently.

The Government Order states that "it is felt, however, that the time has arrived to make more intensive efforts in at least some selected villages, of each district so that these villages may eventually serve as examples of good Panchayat administration which less advanced ones may be induced to follow".

"At the same time it is desirable that the Development Departments concerned with rural welfare should also concentrate on propaganda and administration work in the selected villages so far as they can be done without prejudice to their normal activities. This will not only help the officers of these departments to aim at and achieve speedy and tangible results in definite areas, but will also enlarge the scope of the work of the Panchayats".

With the above object in view, the Government have issued the following instructions:—

"(1) In each Revenue sub-division about 8 or 10 villages should be selected for special attention by the officers of the Revenue and other Departments namely Education, Health, Agriculture, Industries and Commerce and Co-operation; (2) only those villages need be selected in which Panchayats possess adequate income and are working fairly satisfactorily : (3) the items of work to be adopted should be clear in each case with reference to the needs of the locality, the facilities already existing therein and the funds available for the purpose.

The development of selected villages will be a special responsibility of the head of the district, subject to the instructions of the Revenue Commissioner and the Government and the advice of the Development Departments concerned. In order to assist the Deputy Commissioner in the work, an advisory committee consisting of the Revenue Sub-divisional Officer (as organiser and convenor) and the local officer of the several development departments in the district may be constituted. The members of the Committee will arrange to tour the villages once a quarter and review the progress of work made and settle the lines of future work.

The subjects for special study in the selected villages will be among others (a) raising the standard of Village Panchayats administration (b) propaganda of better farming methods including the supply of good seed (c) rural credit and (d) marketing of commercial crops ".

I have quoted this at some length as I want to suggest the adoption of a similar method, modified if necessary to suit our conditions, to gain our ends.

The object of the Department should be to gradually shift the work of Agricultural Development from the shoulders of Government to those of the people themselves, recognising that it is not that which is done for the people but that which is done by the people that is truly beneficial and that real progress can come only from within; this transference of work is impossible unless there are popular bodies to take up the work.

These popular bodies may be Agricultural Associations as in the case of Japan. Co-operative Societies as in the case of Denmark or Village Panchayats as contemplated in Mysore. As the former two have not succeeded so far in spite of the best attempts of the Department, statutory bodies like the Village Panchayats may be brought into existence in large numbers throughout the length and breadth of the country.

We have our own Village Panchayats in the Madras Presidency but fresh life should be infused into them and they should be established in every village as quickly as possible. Their duties and responsibilities should be widened according to their capacity to bear the burden. At present their duties are confined to improve the Village sanitation, health and education. It would appear that no serious attempt has been made to introduce Agricultural improvements in the functions of the Village Panchayats. Unless the material prosperity of a village is improved, the realisation of other improvements, sanitation, and health is bound to be very slow. The primary source for the material prosperity is increased out-turn from land, and this can be obtained through the adoption of improved methods of agriculture. Therefore the rapid spread of agricultural improvements should be the statutory obligation of Village Panchayats.

The time seems to be propitious. There is a very large mass of educated unemployed who can be pressed into the service of these Panchayats on nominal salaries. Knowing as we do the competition existing among them even for posts of attendars there need not be any apprehension with regard to securing their talents at a price the country can afford to pay at present for the purpose. The cheap and healthy village life and the opportunity of being pioneers in the line will induce them to work whole-heartedly any scheme launched by Government to gain the end in view.

To secure the Co-operation of the villagers themselves in the working of any scheme that may be launched, some element of compulsion may be necessary.

As one Indian Economist observes "a truth of supreme importance which all should bear in mind at the present moment is that no Government in India can give any effective help for the betterment of rural conditions by measures which do not contemplate the co-operation of villagers themselves. Another truth of equal importance is that at present the individualistic spirit which has basked under the British flag for decades together will not permit even the out-of-the-way villager to heartily co-operate with Government agencies in rebuilding rural structures."

An enlightened Government must force at some stage the unwilling patient to swallow the (bitter) pill. In India co-operation by the people in rural economic development must be made compulsory by law.

"In numerous directions we want improvements. Government alone cannot hope to bring them about ; people by themselves, have no means, no enlightenment, no eagerness for the common good. To bring about consolidation of farms, redemption of agricultural land from oppressive debt, freedom from unemployment and scarcity of labour and many other economic reforms, the British Indian Legislatures and the authorities in Indian States must have recourse to compulsion as the timely expedient ; there is no other method of belling the cat.

We have now a sympathetic agricultural Viceroy who is all for action. The Central Government's rural grants have been increased and we expect it to become a regular feature in years yet to come. The whole of thinking India is interested in rural development. Our educational system and programme are about to be reorganised. It is said that the Central Government is in consultation with the Local Governments about the appointment of an expert committee to go into the whole question of educational reform. It is hoped that realising the position and importance of agriculture to the country, a definite bias will be given to agriculture at every stage in the curriculum ; and not be content with having rural education, general and agricultural education, technical.

We are about to enter the stage of Provincial Autonomy with prospects of having Federation at the top of it within a few years. Without the reform of the man at the plough brought about by the initiative and co-operation of Village Panchayats and liberal support of the Government, the new era may yet see us far away from the millenium which it is expected to usher in.

Soils, rainfall, and agricultural practices vary widely from district to district and often between different places in the same district. In

order to increase the opportunities for research, to enable science to solve the peculiar agricultural problems of each district and to act as the local store house of all agricultural development and propaganda, it is essential that there should be one or more of Agricultural Farms in each district. Such farms may be run wherever practicable by the local Village Panchayats, Co-operative Societies or Agricultural Associations.

The possibilities of carrying home the latest developments in agriculture to the minds of young and old through movies and talkies should be explored and utilised.

In carrying on Agricultural propaganda one cannot afford to neglect the new vista of development opened up by broadcasting. Western countries true to their traditions have already made rapid strides in this line. Already some of our sister provinces like the Punjab are leading in this matter. When the Village Panchayats come to function all over the Presidency broadcasting will have to be increasingly resorted to, to educate the ryot.

SORGHUM FOR POPPING

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Sorghum, *cholam* (Tam) or *jonna* (Tel.), is one of the staple food grains of the poor and backward classes in the presidency. One of the ways in which sorghum grain can be used as a food or delicacy both by the poor and by the rich is by converting it into pops. Pops (or puffed grains) are obtained by subjecting sorghum grains to sudden heat.

Popping is done by putting small quantities of grain on a hot pan kept over a steady fire. For popping large quantities mud pots are generally used, while for small quantities, small iron pans are found to be suitable. To get uniformly good pops the grains should be a layer thick at the bottom of the pan. To ensure the proper heating of all the grains they should be briskly stirred. A small brush made out of the midribs of the coconut leaf serves this purpose well.

As the grain gets heated by contact with the hot pan it swells slightly and a longitudinal crack is developed on the bulging endosperm of the grain. This crack widens, and irregular cracks are formed cross-wise and the white endosperm is thus exposed. The grain expands into a chalky white puff, which is usually hemispherical in shape with bits of the everted seed coat sticking to its bottom. A pop may be likened to a tiny cauliflower in general appearance. When the cracking is not regular, the pops assume various shapes ; some expand

lengthwise, while others expand breadthwise, thus giving rise to long narrow pops. The various stages leading to the ideal pop are presented in Fig. 1. Except the loss of vitality, the tiny embryo remains undisturbed in popping. Beyond being rent up in the process of popping, the seed coat remains structurally not much altered. The colour of the pericarp is also not affected. When coloured grains are popped the colour persists in the bits of adhering seed coat and is set off by the prominent white background on which they appear.

In maize the varieties suitable for popping go under a group called pop corns. In sorghum there is no such group or varietal name indicating suitability for popping as such. Trials were, therefore, made with different varieties and the results are given below. Table I gives the varieties in which good pops were obtained. Table II gives the list of varieties that do not pop and evert. They merely swell and crack.

Table I.

Sorghum Roxburghii var. *hians* Stapf.

No.	Varietal Name.	Place.	Grain colour.	Popping Expansion— With evertion.
M. S. 2265	Konda jonna	East Godavary Dt.	Red	X 17
A. S. 667	Muthyala jonnalu	Hindupur	White Pearly.	13
A. S. 1947	Selection from a cross		Brown	13
A. S. 668	Alankara cholam	Palakuppam	White Chalky	12
A. S. 572	Pedda jonna	Rajamundry	,, ,,	11½
A. S. 1899	Selection from a cross		,, Pearly	9½
A. S. 468	Pallaki jola	Kollegal	,, ,,	9
M. S. 1764	Alankara cholam	North Arcot	,, Chalky	9
A. S. 403	Talai virichan cholam	Goundanpalayam (Coimbatore)	,, ,,	9
A. S. 679	Jonna	Parlakimedi	,, Pearly	8½
A. S. 1093	Singara cholam	Nagari (Chittoor)	,, Chalky	8
A S. 1006	Khed jonna	Nowrangpur (Vizagapatam Agency)	,, ,,	8
A. S. 1055	Talai virichan cholam	Palladam	,, Pearly	8
A. S. 1086	Kaka cholam	Dharmapuri (Salem)	,, Chalky	7½
M. S. 1755	Alankara cholam	Tiruvannamalai	,, ,,	7½
A. S. 566	Pedda jonna	Berhampur	,, ,,	7½
A. S. 1902	Selection from a cross		,, ,,	7
A. S. 678	Jonna	Hiramandalam (Ganjam)	,, Pearly	6½
M. S. 1793	Kaka cholam	Gudiyatam	,, ,,	6
A. S. 1090	Talai virichan cholam	Katpadi	,, Chalky	6
M. S. 1797	Alankara cholam	Vellore	,, ,,	6
A. S. 1008	Khed jonna	Nowrangpur	Brown	6
M. S. 1563/c.	Sitamma jonna	Madanapalle	White Pearly	5½
A. S. 2160	Selction from a cross		,, Chalky	5½
M. S. 1760	Singara cholam	Tiruttani	,, Pearly	5
A. S. 1995	Selection from a cross		Red	5

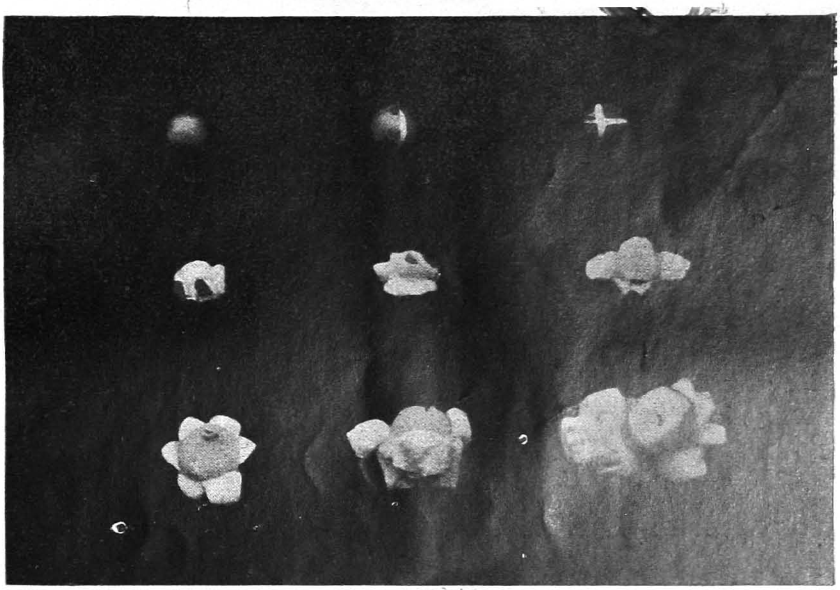

Fig. 1. STAGES IN POPPING

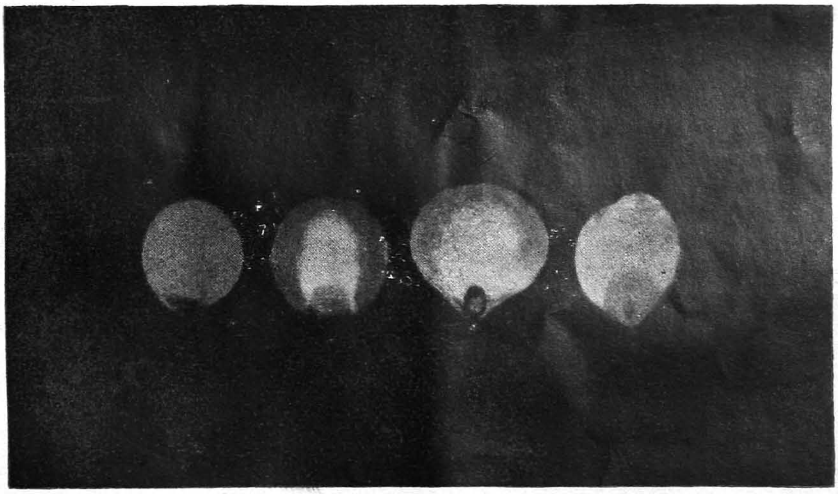

Fig. 2. CORNEOUS TO FLOURY ENDOSPERM

Table II.

Durra group.

No.	Varietal Name.	Place.	Grain colour.	Swelling & cracking— without evertion.
Sorghum Durra Stapf				
T-6	Patcha jonna	Nandyal	Yellow	X 4
A. S. 29	Peria manjal cholam	Coimbatore	,,	3½
A. S. 1098	do.	,,	,,	3
M. S. 1689	Makkattai cholam	Salem	Pink	2½
M. S. 1690	do.	South Arcot	,,	2½
Sorghum subglabrescens Schweinf. et Aschers.				
A. S. 792	Uppam cholam	Coimbatore	White chalky	3½
A. S. 190	Peria vellai cholam	,,	,, ,,	3
A. S. 189	do.	,,	,, ,,	2½
A. S. 127	Sen cholam	,,	Red	2½
A. S. 131	do	,,	,,	2½
A. S. 818	Chinna manjal cholam	,,	Yellow	2½
A. S. 378	Uppu vellai	Jellipatti (Coimbatore)	White chalky	2½
A. S. 389	Sen choalm	Kodaikanal Road	Red	2½
A, S. 841	do	Erode ,,	,,	2½
A. S. 727	Chitrai vellai cholam,	Coimbatore	White chalky	2½
A. S. 723	do	,,	,, ,,	2
A. S. 732	do	,,	,, ,,	2
A. S. 1151	Chinna manjal cholam	,,	Yellow	2
A. S. 367	Vellai cholam	Dindigul	White pearly	2
A. S 809	Chinna manjal cholam	Coimbatore	Yellow	1½
A. S. 1575	Selection from vellai cholam,	Salem	White chlky	1½
A. S. 2095	do	Dindigul	,, Pearly	1½
Sorghum cernuum Host				
T-12	Tella jonna	Bellary	White pearly	3
T-1	do	,,	,, ,,	2½
Sorghum dochna Snowden				
M. S. 2244	Irungu cholam	Kovilpatti	Brown	3

It will be noticed that the first group, namely *S. Roxburghii* var. *hians* (Table I.) is the group which pops best. The group is wide spread and its varieties are cultivated all over the presidency. This group has loose streaming panicles and many of the varietal names are connotative of this. This group will hereafter be referred to as the *Talai virichan* group. It is characterised by small horny grains which do not cook well. These grains are borne in glumes which gape out and leave the grain to develop and mature quite exposed in the late cold weather. The colour of the grain is mostly white. It may be pearly or chalky. Red and brown grains are rare in this group, though they also pop equally well. In Table II it will be noticed that typical grain sorghums like *Peria manjal cholam*, *Tella jonna* and *Pacha jonna* and others belonging to the big Durra group and also the *Irungu cholam* of Tinnevelly do not pop well.

Among foreign varieties tested, a sample of Guinea corn from Jamaica was found to pop very well and equalled the best local variety (*Konda jonna* of the Godavary Agency).

Of others, varieties with dimpled grains do not pop at all. In these the dimple swells and the grains become rounded. The seed coat merely cracks. Grains with waxy endosperm do not pop; in these the grains crack and burst open but do not evert.

The varieties that pop well being thus determined, the study of popping was examined in greater detail. Grain size was examined. This was done by measuring the grains in a 20 c c. glass cylinder and counting the number in that volume. The number of grains per 20 c. c. in popping varieties is given below in their decending order.

Table III.

Popping Varieties (The *Talai virichan* group).

No.	Varietal name.	Place.	No. of grains in 20 c. c.	Popping Expansion
A. S. 1006	Khed jonna	Nowrangpur	1471	8
M. S. 1764	Alankara cholam	North Arcot	1429	9
M. S. 1755	-do-	Tiruvannamalai	1398	7½
M. S. 1793	Kaka cholam	Gudiyattam	1396	6
M. S. 1563/c	Sitamma jonna	Madanapalle	1377	5½
M. S. 1797	Alankara cholam	Vellore	1361	6
A. S. 1093	Singara cholam	Nagari	1355	8½
A. S. 2160	Selection from cross		1328	5½
A. S. 1090	Talai virichan cholam	Katpadi	1306	6
A. S. 1008	Khed jonna	Nowrangpur	1217	9½
A. S. 468	Pallaki jola	Kollegal	1124	9
A. S. 1055	Talai virichan cholam	Palladam	1087	8
A. S. 679	Jonna	Parlakimedi	1055	8½
A. S. 1086	Kaka cholam	Dharmapuri	957	7½
A. S. 678	Jonna	Ganjam	947	6½
A. S. 668	Alankara cholam	Palakuppam	937	12
A. S. 1902	Selection from a cross		918	7
A. S. 566	Pedda jonna	Berhampur	908	7½
A. S. 572	-do-	Rajahmundry	908	13½
A. S. 667	Muthyala jonnalu	Hindupur	908	13½
M. S. 2257/a	Sitamma jonna	Madanapalle	845	5½
A. S. 1899	Selection from a cross		813	9½
A. S. 403	Talai virichan cholam	Coimbatore	801	9
M. S. 2265	Konda jonna	East Godavary	709	17
M. S. 1760	Singara cholam	Tiruttani	688	5

From the above table it will be noticed that the number of grains in 20 c. c. in this *Talai virichan* group ranges from 700 to 1,400. Similar counts were taken in 30 grain sorghum varieties of the Durra group and they ranged from 400 to 800 only thereby indicating the smallness of the grain as one of the attributes of a popping variety. It may be added that the fluctuation in the grain number of the popping varieties is not keeping parallel to the fluctuation in popping

expansion thus giving a hint about the existence of factors other than mere size, determining popping quality.

The density of the grain was therefore gone into. This was determined as follows. A known weight of grain was taken in each variety. Its volume was determined by the displacement of kerosine oil in a graduated measuring cylinder. The use of the kerosine oil was to avoid the soaking of the grain which will happen if water were used. The results are given in the following Tables, IV and V.

Table IV.

Density of Popping Varieties.

No.	Density gm/cc.	Popping Expansion.
A. S. 468	1·42	X 9
M. S. 2257/a.	1·42	5½
A. S. 667	1·40	13
M. S. 1563/c.	1·40	5½
A. S. 1899	1·38	9½
A. S. 2160	1·38	5½
M. S. 1797	1·38	6
M. S. 1760	1·35	5
A. S. 668	1·33	12
A. S. 572	1·33	11½
A. S. 1090	1·33	6
A. S. 403	1·31	9
Average	1·37	

Table V.

Density of Non-popping Varieties.

No.	Density gm/cc.
A. S. 189	1·31
A. S. 1098	1·31
A. S. 29	1·29
A. S. 1575	1 29
A. S. 389	1·29
T - 1	1·27
A. S. 367	1·27
A. S. 809	1·23
A. S 732	1·20
Average	1·27

It will be seen that the popping varieties have a slightly higher density than non-popping varieties. Relatively to size, the weight of the grain of the popping varieties is greater. In popping varieties, degrees of density do not correspond to popping expansion.

A number of grains were cut open and their examination showed that the endosperm of sorghum grains may be either wholly mealy or often with a mealy centre surrounded by a corneous exterior. The amount of this corneous layer varies between varieties (Fig. 2). In the good popping ones the endosperm is entirely corneous or occasionally with a very little floury endosperm at the core. Non-popping varieties are characterised by a thin horny exterior and plenty of meal inside the grain.

In *Sorghum margaritiferum*, a group of sorghums from Africa with very small lustrous, horny grains, the popping expansion was small (x2½ to 3½). An examination of the grain sections revealed that the seed coat of this variety was thin compared to *Sorghum Roxburgii*. In *Sorghum margaritiferum* it was about 35 μ while in *Sorghum Roxburgii* var. *hians* it ranged from 70 to 125 μ. It will thus be noticed that in

addition to a horny endosperm, a thick pericarp is necessary to produce good pops.

Moisture determinations were made in eight *Talai virichan* varieties and found to be between 10 and 11 per cent. Analyses of grain and pops from a variety of *Talai virichan cholum* were kindly made by the Agricultural Chemist, who remarks, "No difference could be noticed as a result of popping in respect of (1) food values, (2) mineral values and (3) total sugars and starch contents. During popping the starch may undergo certain amount of dextrination which might make it more easily digestible."

From the above examination it will be seen that popping varieties belong to the *Talai virichan* group of sorghums (*S. Roxburghii* var. *hians*). They are characterised by small grains with a corneous endosperm. Their seed coats are somewhat thick. Discussing the causes of the popping in maize, one of the reasons for popping is set down by Willier and Brunson* to the presence of enough moisture in the grain which when converted by heat into steam results in a violent expansion and the evertion of the endosperm. A similar cause seems to be responsible in sorghum also as the analysis of pops shows no differences other than loss of moisture.

Enquiries through District Officers into the popping of sorghum as a cottage industry show that this industry exists in isolated places, the product being consumed locally as balls mixed with jaggery, especially during fairs and festivals. It is reputed for its fine flavour and good digestive qualities. When the suitable type of grain is not available locally, the grain is imported from the Coimbatore and Cocanada areas of the presidency. There are reports of importations from Burma also. Whether this indicates a more favourable freight position, compared with local movements by rail, is a subject of investigation by the Marketting Officers.

In sorghum pops, the poor and the rich have a cheap and wholesome luxury.

Summary. Popping varieties of sorghum belong to the *Talai virichan* group (*Sorghum Roxburghii* var. *hians*). They are characterised by small grains with a corneous endosperm which is very dense. The seed coats of the grains are comparatively thick. The grains have a moisture content of about 10 per cent. In popping this moisture is converted into steam. This steam seems to find a resistance in its escape from the thick seed coat with the result that there is a sudden bursting and expansion and the packed starch grains expand with a violence, and give pops.

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* Factors affecting the popping quality of Pop-corn by T. G. Willier and A. M. Brunson. Journal of Agricultural Research Vol. 35 page 615—627. 1927.

RESEARCH & PROPAGANDA WORK IN BEEKEEPING

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Insects are always regarded as man's enemies, since they devastate his crops, attack store grains, inflict injury on his live stock and above all annoy him personally. Likewise the Entomologist has been looked upon as a destroyer of these insects. But there is another side of the picture. Among insects are some which are man's friends. The predators and parasites which feed on crop pests, the weed killers like the prickly pear Cochineal, and silkworms, lac insects and honey bees from which valuable products are obtained, are all instances in point. Of these insects, the honey bees which form the subject of the present paper, besides giving us honey, also help in pollinating our plants.

In these days of economic depression there are immense possibilities for beekeeping as a side line to farming. The Madras Agricultural Department is trying to popularise beekeeping as a cottage industry. At the Apiary, started at the instance of the Director of Agriculture, research on various aspects of bee-keeping is being carried on. While in the western countries, the European bee—*Apis mellifica*—has been studied in detail, it has to be admitted that the data available on the Indian bee (*Apis indica*)—the only one of the indigenous bees which can be domesticated—is very meagre indeed. Hence the need for detailed studies of our Indian bees.

Items of Research. The main items of research carried on at the Apiary are (1) bee enemies, (2) trials of acclimatising the Hill variety of the Indian bee in the plains, (3) artificial feeding of bees, (4) queen rearing, (5) effects of shifting bee colonies, (6) bee pasturage, (7) range of flight, (8) the decrease and increase in the weight of colonies during different seasons, (9) the life history of the bees and egglaying capacity of the queen, and (10) beekeeping appliances.

1. *Enemies of Honey bees.* There are a number of enemies of the honey bee of which the *wax moth* is the most important. The ravages of this pest to honey combs are well known throughout the world. Its damage is conspicuous in Coimbatore from June to October. A few additional and interesting points in the life history and control of this insect were noted during the course of work here. The female prefers hidden and safe corners, narrow slits in the body of the hive, the cover of crushed cells in the comb etc. to lay eggs. Very often the egg-masses are found in slits which would hardly admit the slender ovipositor of the female moth. The moths need not enter the hives and

lay their eggs on the combs, since the active caterpillars, on hatching, are quite capable of finding their way to the combs. The maximum number of eggs laid by a single female in her life time was 868 and these were laid within the first three days after copulation. The egg period lasts for 8 days, the larval period for about a month and the pupal period for another 8 days.

Feeding habits of the caterpillars—The natural food of the worms appears to be only old combs with plenty of lining with "Propolis" and pollen collected and stored by bees. The caterpillars do not feed on wax, foundation combs or even newly constructed combs.

Longevity of the adults—In captivity, the male moths were found to live from 18 to 27 days with food and the females from 6 to 10 days.

Control measures—Apart from those already advocated such as frequent examination of hives and destruction of caterpillars from infested combs, keeping colonies strong, etc., a few other methods of control of this pest have been under investigation. A simple method to eliminate the worms from stored combs was found quite effective. The infested combs are exposed to the sun for a few minutes taking care to see that the temperature does not exceed 40°C. The worms being unable to bear the heat, wriggle out and collect themselves under the comb from where they could be easily picked and destroyed. The silken webbing woven by the caterpillars can be removed easily with a brush and the small holes in the combs are promptly repaired by the bees when the combs are given back to them. This simple method obviates the necessity for fumigating the infested combs with costly chemicals such as Carbon bisulphide, Sulphur, etc., as it is being done in the western countries.

From a study of the egglaying habits of the moth, a possible line of control is under investigation. It has already been mentioned that the eggmasses are usually laid in cracks and crevices in the hive body. Elimination of such defects by keeping the brood chamber super and roof in their proper positions will minimise the chances of infection. But, in spite of such precautions, eggmasses are often found laid in the narrow space between the brood chamber and the top or super. An Apiarist, having a trained eye, can easily detect the presence of these eggmasses and scrape them off but as the eggs are likely to be laid in the inaccessible and hidden crevices of the hive body the body may be changed as often as possible in cases wherever such infection is suspected.

Another bee enemy which has been studied is the bee hunter wasp (*Palarus orientalis*). This is a small wasp about 1¼ c. m. long, dark in color with transverse yellowish white stripes on the abdomen and thorax. It has recently been noted as a predator on bees at Tiruchengode, Coimbatore and Ponnani and is capable of doing considerable

damage. Since the pest has been noted for the first time in South India, attempts were made to study its life history and habits. The wasp is very active in its habits and makes underground tunnels with separate compartments to stock its prey which serves as food for its young ones. It waits near the entrance of bee colonies and being endowed with powers of quick flight it is able to snatch away bees and stock them in its underground home. Each wasp was found capable of collecting about 20 bees in a day, the time of hunting being limited to bright mornings and afternoons. Eggs are laid by the female wasp between the head and thorax of the prey ; one egg being laid for each group of 4 or 5 bees in a compartment. The grub hatches out on the second day and begins to feed on the food provided by its parent. The grub is able to feed on all the bees in about 5 days by which time it attains its full growth. The pupation takes place inside an earthern cocoon made by the grub itself from which the adult emerges. Details regarding the actual pupal period and control measures against the predator are under investigation. The damage caused by these predators is sometimes serious since each wasp is capable of robbing about 20 bees in a day. Apart from the actual loss of the bees the disturbance caused by frequent visits of these robbers upset the routine work of the colony.

2. *Trials with the Hill variety of the Indian bee.* A dark variety of the Indian bee occurs in the Hills. The bees are bigger in size and darker in color than the Plains variety and are better honey gatherers. A colony of these got down from Coonoor was found to thrive well even under adverse conditions on the plains. Preliminary trials indicate that the hill bees are more prolific breeders and better workers. The colony under observation yielded double the quantity of honey obtained from a colony of plain bee kept under similar conditions. There was also an improvement in the temper of the Hill variety after coming over to the plains. A few more colonies have been brought from Coonoor for further trials to find out the possibilities of introducing these on the plains.

3. *Trials on the artificial feeding of honey bees.* Honey and pollen from flowers are the two important natural foods of the honey bee and the grubs. But during periods when flowers are not available, ways and means have to be found to substitute the natural foods by artificial material. Sugar and jaggery syrup, sugar candy and dilute honey are freely given as artificial food. As regards the substitute for pollen, the Italian bee in the western countries is said to utilise various articles such as spores of fungi, particles of saw dust, fine earth from swamps, rye, barley, linseed and pea meals, dry milk, white of eggs.

Based on the above facts, a few trials were made to find out the artificial substitutes of these bee foods for our Indian bee under South Indian conditions. Jaggery solution and sugar syrup were tried

separately and the bees fed on them eagerly and later converted and stored them as honey in their cells. Of the two, sugar syrup was consumed with greater avidity.

To study the qualities of the product from the two samples of food given, two hives were liberally fed with sugar syrup and jaggery solution respectively and honeys extracted separately and analysed. The figures obtained clearly indicate that there is very little difference between the synthetic honey and the natural product in the chemical composition but there is difference in the aroma and taste. The jaggery honey was dark in colour with a strong smell of molasses while the sugar honey was pale yellow in colour and poor in aroma and taste.

Incidentally, the concentrations of the liquids supplied as food and the honeys extracted from these hives were studied. The concentration of the jaggery solution supplied was 37·7% and that of the honey extracted was 71·4%. Similarly the strength of the sugar syrup fed was 53·4% whereas the honey showed a strength of 74·2%. This shows that the bees in the course of their manufacture of honey have eliminated respectively 33·7% and 20·8% of moisture in the jaggery and sugar solutions fed to them.

As for pollen substitutes various material such as Bengal gram flour, linseed and pea meals were tried separately as well as mixed with honey and the feed was given both inside the hive as well as kept outside near the hives. But none of these were favoured by the bees. Before concluding this aspect of research it may be mentioned here that artificial feeding with a honey substitute, whatever its advantages may be, has to be limited to the minimum, since it has its evil effects when taken beyond the limit. In nature, bees are accustomed to take in only minute quantities of nectar at a time and to converting them into honey prior to storing. And whenever any extraneous food such as sugar syrup or honey, is given to them they have a habit of gorging themselves which is as harmful to bees as is to human beings. The effects are much worse in cases where the substitute is sugar solution since the bees have to invert the sucrose contained in the sugar into dextrose and levulose in their stomach thereby causing undue strain on their delicate digestive system. Therefore bees should be fed artificially only when it is absolutely necessary. The food should be given in small quantities and stopped as soon as an adequate supply is found stored in the cells. A better alternative would be to leave a sufficient quantity of the honey stored by the bees in the combs so that they can draw on this reserve food during times of scarcity.

As regards pollen substitutes, since our Indian bees do not show any tendency to accept any artificial material the only alternative is to grow some quick growing pollen yielding crops such as maize, cumbu, niger or sunflower in times of scarcity of pollen.

4. *Queen rearing.* The necessity for spare queens is, often felt, especially during the swarming season, when new queens get lost during their nuptial flight. The "Demarree" method of swarm prevention presents a very easy and convenient method of queen rearing. The procedure is briefly as follows:—A colony having a queen with desirable traits and with plenty of brood and eggs is selected. The colony is examined and the brood comb with the queen and bees is taken out and kept in a separate hive. The rest of the frames are given either with foundation or spare combs. A "queen excluder" is placed on the top of this box and over this the old hive with the other brood combs and bees is kept. The entrance of the upper hive is closed and both boxes are tied securely so as to prevent their toppling over. The queen excluder prevents the queen from having any access to the upper chamber as a result of which the workers there begin to rear queens out of the fertilised eggs. After the queen cells are sealed the frames along with the bees and the queen cells are taken out and distributed in a few hives. Thus, about half a dozen nucleus colonies are obtained from a single colony. The success of this method depends upon the prosperity of the season. Healthy queens are reared only during seasons when pasturage is available in plenty. Attempts made to send spare queens by post to different parts of this Presidency have been successful and this method enables us to send spare queens to parties requiring them.

5. *Effects of shifting bee colonies and memory of bees.* While managing an Apiary it may often be found necessary to shift bee hives from place to place for various reasons. Our experience shows that such shiftings should, as far as possible, be avoided since the colonies receive a set back from which they take over three weeks to recover. To study the effects of shifting, five colonies were first weighed and transported from our Apiary to a village about 2 miles off. The colonies were weighed on alternate days in the new locality. In spite of the fact that the latter place afforded much better pasturage facilities there was a steady decline in the weights of all the hives for the first ten days and it took another ten days to attain the original weight. The maximum loss of weight in one case was about 1 lb. 4 ozs. and the minimum was 6¼ ozs. The decrease is partly due to the rapid consumption of the reserve food material and partly due to a good number of the field bees straying away. Egglaying and brood rearing were not materially affected so long as pasturage conditions were satisfactory.

Incidentally, mention may be made of the strong memory of bees as it has to be taken into account while shifting bee colonies. When colonies are shifted from an apiary to a distant place and brought back within three weeks and kept anywhere near the original place, the returning foragers, by virtue of their memory of their old place,

have the habit of going back to that spot instead of returning to their hive. But this difficulty could be avoided if the colony is brought back to the original apiary after about six weeks, i. e., after the generation of the bees accustomed to the old place, have died out.

6. *Bee pasturage.* Before starting an apiary in a locality an accurate knowledge of the honey and pollen yielding flora of that locality is essential. The bee pasturage crops of Coimbatore as well as of the other districts of this Presidency were studied as opportunities occurred and we have now a list of most of the bee pasturage plants along with their months of flowering. The list is, by no means, complete and further work is necessary to make it more comprehensive. Attempts are also being made to introduce bee pasturage plants of economic value from elsewhere.

7. *Range of flight.* A knowledge of the range of flight of the bees is necessary for selecting the site for an apiary in relation to its proximity to the pasturage. The European bee is said to travel up to two miles for forage. But the range of flight of the Indian bee seems to be rather limited since bees from colonies shifted to a distance of about 4 or 5 furlongs from the original place did not come back to the previous place in spite of their pronounced homing instinct. The longest distance that our bees were noted to travel was about 3 furlongs.

8. *The decrease and increase in the weight of colonies during different seasons.* In our Apiary it is found that there is a phenomenal reduction in the strength of the bee colonies from June to October followed by a proportionate increase from November to May. In the absence of a better index of the prosperity or otherwise of a bee colony its condition was judged by its weight. Weights of a selected number of colonies were taken every fortnight for three years during adverse as well as prosperous seasons. The maximum decrease in weight during the lean season was 71% of the original weight, the increase during the subsequent prosperous season being 68%. The main reason for such striking variations is due to the availability or otherwise of bee pasturage. Colonies that have considerably dwindled in strength during the slack season are practically useless during the ensuing honey flow season as they take a pretty long time to rear up sufficient worker force for honey gathering; whereas the colonies that have not been affected by the adverse conditions begin to collect and store honey from the very start of honey season.

The main conclusion that can be drawn from the above investigation is that the secret of success in managing an apiary profitably, lies in the availability of sufficient pasturage throughout the year and the industry will not pay in localities where such conditions do not exist. Granting that the pasturage conditions are favourable the next important aspect of the industry is to build up the strength of the colonies

by certain special methods such as provision of additional breeding facilities, uniting colonies, artificial feeding, etc., just prior to the honey season so as to have the maximum number of workers, to collect and store honey from the very advent of the honey flow season. Incidentally, seasonal conditions also appear to play an important part in the economic aspect of beekeeping. Failure of rains as it has been the experience for the past three years, affects the nectar secretion in flowers and a continued rainy or windy weather prevents the bees from going out and thus curtails their activity.

9. *Life history of the bees and egglaying capacity of the queen.* Along with the above line of investigations, observations were made to find out whether the rapid increase in the population of the hives, during prosperous seasons, is brought about by the shortening of the life cycle or by a more prolific egglaying by the queen or by both. The average period of life cycle was found to be uniform throughout the year irrespective of the external conditions-the egg stage lasting for 3 days, the larval stage for 4 days and the pupal stage for 12 days; the total life cycle not extending over 19 days. On the other hand, the increase in the population is brought about by the higher rate of egglaying, the daily average rate being about 300 eggs (which may even go upto 500 per day) whereas the rate is reduced to about 30 or 40 a day during the slack season.

10. *Beekeeping appliances.* Due attention was paid to this aspect of the work.

Honey extractor—An improved type honey extractor with a brass container and a special ball bearing device was evolved. The machine is priced at Rs. 9 only and there is a considerable demand for it.

Drone trap—Occasionally, the control of the drones becomes a regular problem and a simple drone trap, with the help of which the drones can be isolated and killed, was devised. The trap consists of a piece of wood about 2″ wide, the length being adjusted according to the width of the entrance. On the lower side of this block of wood there is a shallow cut of about ⅛″. Drones are generally found in numbers in the supers as well as on the top of the frames. In such cases, the super is removed and the top put on. The super frames are then taken out and the drones picked and crushed. To prevent the drones that might escape from entering the hive the drone trap is kept close to the entrance with the cut end below. The narrow space of ⅛″ is just enough to allow the workers inside and excludes the drones which have a thicker build. The latter can be easily disposed of since they collect themselves in large numbers, at the entrance. In the case of the hives which have no supers, the trap can be successfully used during the evenings when large numbers of the drones come out for their play flight.

Other items of research such as swarm prevention, artificial granulation etc. are in progress; the results of these investigations will be given in a later paper.

Propaganda. The popularity which beekeeping is gaining as a cottage industry is indicated by the steady demand for advice and appliances from all over the Presidency as well as from other provinces of India. Owing to the activities of the department as well as those organisations like the Rural Reconstruction Centre, Ramanathapuram, over 1000 hives distributed among 130 villages are being maintained in this Presidency. The figures given are those obtained last year. The department, in spite of inadequate equipment is doing its best to popularise this industry. A colony of bees along with some of the apicultural appliances has now become a regular feature in almost all the exhibitions and fairs. In addition to this, numerous demonstrations in hiving wild colonies and in the care and management of apiaries have been conducted in various parts of the Presidency. Apicultural requisites such as hives, extractors, smokers, are being made and supplied to the public almost at cost price. In order to popularise this industry further, short courses in beekeeping, for about a month during February are being held for the past two years. More than 50 young men have been trained in the subject and it is hoped that they carry their knowledge of the subject to the very door of the ryot.

A departmenal bulletin—Bulletin No. 37 – Beekeeping in South India—and a pamphlet on the subject were published and the popularity of these publications has been more than what was expected. A leaflet giving practical hints for amateur beekeepers is under preparation.

Before concluding this paper a word may be said about the economics of beekeeping. The appliances needed are not many nor are they costly. A teakwood hive with a colony of bees costs Rs. 5 only. On an average 6—10 lbs. of honey is got in a year from a hive fetching Rs. 7—8—0 to Rs. 12—8—0 at Rs. 1—4—0 per lb. Thus, if a ryot keeps at least 3 or 4 hives he can get about Rs. 30 per year. It will therefore be seen that the possibilities of beekeeping as a cottage industry are great.

Research Notes.

A Note on the interspecific cross in the Cucerbits.

Intergeneric and Interspecific crosses in the family Cucurbitaceae were attempted at the Agricultural Research Station, Pattambi. While the intergeneric crosses were failures some of the interspecific crosses were successful. A brief description of a successful interspecific cross is given below:

One of the two species chosen for the cross, *Luffa acutangula*, is a cultivated variety the fruit of which is commonly used as a vegetable; the other species

Luffa ægyptiaca, is a wild variety and is commonly found growing along hedges, and is fairly drought resistant. The object of this cross was to introduce the hardiness and drought resistant characters of the wild variety into the cultivated one. The main differences between the two species are given below:

	L. acutangula.	*L. ægyptiaca.*
Leaf	Faintly five lobed	Deeply five lobed
Flower	Opens between 5 and 6 P. M.	Opens between 4 and 5 P. M.
Fruit	Oblong clavate with 10 sharp angles	Large, cylindric and smooth
Seed	Not winged, slightly rugose on the sides	Narrowly winged, smooth on sides

Both the reciprocal crosses were successful, and the setting of seeds was fairly large. The F_1 characters were all intermediate especially as regards the more striking of the characters as observed in leaf shape, flower opening (opens between 10 and 11 P. M.), nature of seed coat, and the shape of the fruit. The F_1 plant put on vegetative growth for a period of about one year from sowing; during this period it had one flush of fruiting during the months of February to May, standing the hot weather conditions remarkably well; after the hot weather and with the commencement of the monsoons it again gave a second flush of fruiting.

The germination of F_1 seeds was very poor and therefore a few plants (about ½ dozen) only could be studied. The few plants that were examined were intermediate in all the characters. The production of pistillate flowers was also very few.

An intervarietal cross was attempted between *Luffa acutangula* and *Luffa acutangula*, var., *amara*. The latter is a wild variety while the former is the cultivated one. The wild variety is exactly like the cultivated one, excepting that the fruit is very much smaller (3 inches long and about ½ inch thick), and the leaves, flowers, etc., are comparatively smaller than *L. acutangula*. In this case the cross between *L. acutangula* (female) and *L. acutangula*, var., amara., (male) was successful while the reciprocal did not fertilize.

The fruit of the F_1 was intermediate in shape; and the F_2 seeds did not germinate for further studies.

C. Rajasekhara Mudaliyar,
(Assistant to the Paddy Specialist).

Agricultural Jottings

BY THE DEPARTMENT OF AGRICULTURE, MADRAS

I. **An Improved Water-Lift for Short Lifts.** An improved water-lift of the circular mhote type has been designed by the Agricultural Department and subjected to a long period of trial with very satisfactory results. It is an improvement on the well known circular mhote so extensively employed in the South Arcot district.

The lift employs two cylindrical buckets which rise and fall, the one ascending full of water whilst the empty one descends. A large hinged flap valve in the bottom of each bucket allows the buckets to submerge and fill as they are lowered into the water at the ends of their supporting chains. Each bucket is hung in an inverted 'U' shaped yoke which is hingedly attached to projecting pins on the

sides of the bucket a little above the level of the centre of gravity and which permits the bucket to tip into a horizontal position when it is raised to the point of discharge. A hinged link or ring on the front of the bucket near the top is loosely coupled to a stout iron rod which is hung down the wall of the well from a cross beam at the level of discharge and causes the bucket to tip and discharge when it comes in contact with the bend or stop at the top of the rod.

The chains which support the buckets pass over head pulleys which are mounted on a frame directly over the buckets and then diverge horizontally to sheave blocks which are mounted on posts situated diametrically opposite to each other at the edge of the circular bullock track and in a line parallel to the side of the well. After passing through these sheave blocks the chains are brought together to their common terminus on the rotating beam. The sheave blocks are mounted about 7 ft. high on the posts to support the chains with sufficient clearance above the animals' horns.

The rotating beam is self-supported on a central post. The pair of animals are hitched to one end of the beam at about 12 ft. from the centre of rotation and the two chains are connected to a swivelling block which may be attached to the other end of the beam at various distances from the centre of rotation according to the depth of water level in the well or the height through which the water must be lifted. If, for instance, the chains are attached at a distance of 6 ft. from the centre of rotation, the up and down movement of the buckets, produced by the rotation of the beam, will be 12 ft or very nearly so. After the chains are connected to the beam at such a distance from the centre of rotation and the length of the chains is so adjusted where they attach to the beam, that the buckets will be lowered well below the surface of the water and will be raised exactly to the tipping or discharge position, no further adjustment is required unless of course there is any considerable change in the water level due, for instance, to a fall in the water table in the dry season or a rise in a wet one.

Both buckets are raised full of water and discharged during each rotation of the beam. The capacity of the buckets normally employed is 16 gallons so that 32 gallons of water are discharged per rotation of the beam. A pair of average sized cattle will average 2½ circuits of the circular track per minute, so that 4,800 gallons are discharged per hour. This is the normal output of the lift when provided with the usual 16 gallon buckets and lifting from depths up to 10 ft. or so. With better cattle 20 gallon buckets may be fitted to give an output of 6,000 gallons per hour. One of these improved lifts with 16-gallon buckets on the Agricultural Research Station, Palur, near Nellikuppam, raising 4,800 gallons per hour, is worked by a single Ongole bull.

The draught, of course, is not uniform but varies from zero to a maximum of about 145 lbs. and back to zero twice during each rotation of the beam. The weight of the strong 16-gallon bucket with all fittings is 58 lbs.

The lift is designed only for short lifts up to about 12 ft. and is therefore only applicable to those districts where high water tables prevail. It could be adapted for somewhat greater depths but not with the same convenience and advantage. It shares this inherent disadvantage with the original South Arcot design of circular mhote but in comparison with the latter it is very much simpler and neater in design and considerably more efficient giving a 45% greater output with the same capacity buckets and the same sized cattle. The cost is considerably less.

This improved design should make a strong appeal to the ryot and it is hoped that demonstration of the lift will lead him to adopt it in preference to the present crude design which in spite of its low efficiency has attained such a popularity in the South Arcot and neighbouring districts.

II. **Active Carbon and Its use.** The industry of jaggery making, though practised in India from very early times, has till now made little progress as regards its technique. The old primitive method of concentrating the juice in open pans over direct fire is still in vogue and no attempt is made at clarification of the juice except uncontrolled liming. The result has been that the jaggery so produced is dark in colour, unclean and of poor quality and therefore fetches only a low price in the market.

2. Nevertheless, the bulk of the cane grown in India (roughly two thirds of the total output) is converted into this crude form of sugar only, for which there is normally a ready demand in the country itself. In recent years, however, there has been a growing demand for white sugar from the well-to-do and educated middle classes and this increasing demand is being met partly by importation from abroad and partly from the rapidly growing local white sugar industry. Despite this rapid development of the latter, jaggery making will continue to maintain its important place in the economy of the Indian ryot as a cottage industry for several years to come, as a large portion of the cane area is bound to be scattered and out of reach of sugar factories. It became therefore an urgent necessity to devise suitable measures for the rehabilitation of the jaggery industry, one of the obvious means being to improve the quality of the jaggery by cheap methods so that it may sell at a higher rate in the market.

3. It is well known that bone charcoal and more recently active carbons of vegetable origin are in general use in refineries for the production of white sugar. Their prohibitive cost (viz. 8 to 10 as. a lb.), however, militates against their economic use for improving the jaggery making process.

4. Investigations were therefore started in the laboratory of the Government Agricultural Chemist, Coimbatore, in 1932 to prepare active carbons from readily available waste materials like paddy husk, groundnut husk, saw dust etc. These efforts were attended with a great measure of success and large quantities of active carbon were produced from paddy husk at the comparatively low cost of about 2 annas per pound.

5. The method of preparation is simple and merely consists in treating the paddy husk char with caustic alkali and removing the alkali by washing with water.

6. The carbon so prepared becomes light and very porous in structure and by virtue of this fact it is able to remove colouring matter and other organic substances from solutions. Thus on treating sugarcane juice with the active carbon, the juice is not only decolourised completely, but also clarified and sterilised to a certain extent.

7. The new process of jaggery making is extremely simple and does not involve any complicated operations or elaborate machinery. The cane juice is raised to the boiling point and then passed through a bed of activated carbon contained in a conical cylinder with a perforated bottom. The juice comes out through the filter colourless and brilliant and is boiled down to jaggery, whole sugar or rab in the ordinary way. The products thus obtained are strikingly superior in colour and quality to those prepared by the local method and are also extremely clean.

8. For the past three seasons, the Department has been conducting demonstrations of the improved process in almost all the important cane growing districts of the Presidency. Except in a very few places, the products have been so good as to arouse the enthusiasm of the most conservative of the ryot with the result that there arose a very great demand for this carbon from ryots all over the Presidency. As it is impossible to meet this demand for obvious

reasons, it was decided to give practical training in carbon making to a number of departmental demonstrators and to as many private individuals as desired this training. As a result, it has been possible to start carbon making this season, in the Agricultural Research Stations at Anakapalle (Vizagapatam) and Palur (South Arcot). A few enterprising and enthusiastic ryots have taken advantage of this training and have also been preparing carbon for their own use.

9. The cost of producing one pound of active carbon from paddy husk roughly works out to 0—1—9 ps. and it has been found that carbon once used can be reactivated at least twice again by strong heating only. The reactivation thus costs very little and it appears therefore certain that the carbon process will not be economically unsound provided arrangements are made for reactivating the used carbon for further use.

10. Paddy husk carbon can also be profitably used for preparing white sugar under the open pan system of boiling. The quality is much better and the yield of sugar or rab is much more than is obtained without charcoal treatment, and one sugar factory has made enquiries about its use for white sugar making.

11. Palmyrah and coconut palm juices have also been found to respond well to charcoal treatment. There is a striking improvement in the colour and quality of the sugar and jaggery obtained from these juices as a result of carbon treatment. The characteristic palmyrah odour usually present in these products is entirely removed.

12. Yet another use to which paddy husk carbon has been put is for the clarification of oils. Cocoanut oil becomes colourless and brilliant on filtration through this carbon. Castor oil is deprived of almost all of its repulsive odour and Gingelly and Groundnut oils become considerably lighter and purer after carbon treatment.

ABSTRACTS

Resistance of Sorghum to stem borers. It was noticed from field tests that the extent of infestation by stem borers in Sorghum varies with varieties. The results obtained under controlled conditions would appear to show that the host selection of moths is one of the causes of the phenomenon There has been observed a significant association between infestation and height of plants which may be explained by the assumption that tall plants present more space to the borers attacks than the short and dwarf plants. With a large number of grain colours present in sorghums, white grain varieties have shown comparatively less infestation by borers than varieties with other grain colours. Under controlled conditions 'sorgos' as a group were more susceptible to the attack than the nonsaccharine varieties. (*Amer. Sci. Agronom*, Vol. 28, No. 4, pp. 271-278). K. R.

An Electrical Remedy for Tree Borers. The writer recently rigged up a magneto as an amusement device for a pair of growing youngsters, with which they could give mild shocks to themselves and other youngsters of the neighbourhood. Later, having heard of the method of driving earth-worms out of the ground by electric current, the magneto was turned to this use. When a pair of steel rods wired to the magneto were thrust into wet ground about six inches apart and the crank turned, the earth-worms came crawling out. Still later, when the writer was engaged in the laborious task of digging elm-borers out of a tree with a pocket knife, the idea came of turning the magneto to use for this job. When two nails were driven into the bark a few inches apart in the affected area, the nails attached to the magneto and the crank turned, the elm-borers came out in a few seconds. Subsequent digging in the electrically treated bark proved that the borers had vacated 100 per cent.

The system is much less laborious than digging out the borers and far more amusing. A magneto somewhat more powerful than the writer's would no doubt be quite valuable to orchardists and commercial tree surgeons. (*Science, New Series*, Vol. 84, No. 2167). Victor H. Schmidt, Kansas City, Missouri.

Lucerne as a food for human consumption. (*The South African Institute for Medical Research Laboratory Report No. 3.* Johannesburg).

The publication contains a summary of all the available knowledge on the subject. It deals about the history of lucerne cultivation in S. Africa, the chemical composition of the plant at various stages of growth and suggestions for using lucerne as human food. There are two useful appendices to the publication one dealing about the method of cultivation and the other containing suggestions regarding the value and methods of using lucerne as part of the ration for mine labourers.

Lucerne is remarkably rich in the antiscorbutic vitamin C, being about five times as rich as the same weight of orange juice. It contains a considerable amount of mineral matter, calcium and iron, about three times as much calcium as milk and twice as much iron as spinach. Besides vitamin C, it is also rich in vitamins A, D and E. There is also an appreciable quantity of proteins.

It is advisable to use only the leaves and young shoots as the stalks unless very young are apt to be fibrous. When it is chopped, it should be used as soon as possible and its vitamin C value diminishes rapidly when the cells are damaged. The leaves can be incorporated in a salad just like any other green stuff. It can be chopped and put in omelettes or in soups and stews. The leaves can also be cooked as spinach but in so doing the minimum amount of water should be used. It appears tea can also be made with the leaves. Experiments have shown that even a tablespoonful of chopped lucerne per boy is a useful addition to the ration and an ounce a day is regarded as a fully protective ration against scurvy even without the addition of other vegetables.

While it is admitted that, lucerne as usually grown for forage purposes, is apt to be somewhat coarse and lacking in flavour, it is however possible with sufficient attention to cultivation using rich soil and plenty of water to obtain a vigorous and tender growth which would make it more suitable as a vegetable.

K. R.

Correspondence.

To The Editor, Madras Agricultural Journal.

Sir,

I shall be glad if you will kindly inform me whether the injury due to leaves of tamarind trees falling on a paddy field will be confined to that particular field or it is likely to be transmitted to other fields in case water from that particular field flows to the other fields.

PALGHAT, 1—9—36.

Yours truly,

O. M. MENON

Reply.

The presence of tamarind trees in the vicinity of cultivation is generally considered undesirable owing to the acid nature of the leaves. It is well known that grass does not grow well under tamarind trees, since the leaves are supposed to make the soil acid in reaction.

In the case of paddy fields it is likely that the leaves falling on the field may be deleterious, but it is hardly likely that the acidity so formed will affect other fields, by water flowing into them.

The presence of big trees like the tamarind is not desirable in the vicinity of cultivation not only from the point of excessive shade and effect of acid leaves but also from the point of the roots of such trees exhausting the soil of its manurial ingredients. —Government Agricultural Chemist.

College News & Notes.

We are glad to learn that Messrs. N. Parthasarathy and N. Krishnaswami from the Research Institute, Coimbatore and Messrs. N. Kesava Iyengar and V. Panduranga Rao from the Agricultural Research Station, Hagari, have gone abroad for higher studies. We wish them *bon voyage* and success in their studies.

Students' corner. Hockey:— In view of our College Team touring Ceylon during the Michaelmas holidays our team played a series of matches with the local Colleges and Clubs. In the first match against the Forest College our College won by a margin of 2 goals in 10. The second match was played against the Stanes European High School whom we managed to beat. Perfect understanding was exhibited by our forwards while the defence kept a complete check over the opposing forwards and stopped many moves which would have resulted in certain goals. The Stanes boys played tenaciously throughout the game and when the score was 4—2, the final whistle blew. The third match was played against a combined XI which ended in a win for the College by 2—1. Our College team is a hard working eleven which will take a lot of beating and it is therefore expected that it will give a good account of itself in Ceylon.

Cricket. The cricket season opened with a match against the Government College which ended in a draw. The Government College ran up a huge score of 172 to which Narasimham and Padhan contributed 46 and 28 respectively. The College replied with 100 runs for the loss of 5 wickets when the stumps were drawn for the day. K. Dinker Rao played a stolid innings and remained unbeaten with 60 runs.

Rhondy Shield Tourney. The first match of this tournament was played against the Stanes European High School and the College registered an easy victory. Entering first, the Collegians ran up a total of 168, Narasinga Rao scoring a vigorous 33 while K. K. R. Menon came next with patient and unbeaten 28. The Stanes were dismissed for 121 runs. Mukundan and D. V. Rajagopal captured 4 wickets each at a cost of 16 and 30 runs respectively. The Stanes team exhibited a high standard of fielding, but for which we would have passed the 200 mark easily. In the second match the College suffered a crushing defeat at the hands of the Coimbatore Cricket Club. The College batted first and were skittled out for a paltry 26, Venku and Potts being responsible for the collapse. Venturing out in turn, the Coimbatore cricket club passed our total for the loss of 2 wickets and carried on till the score was 218 for 4. Briggs played well for a patient 59 while Murray and Venku remained with 50 and 40 respectively. D. V. Rajagopal bowled steadily for the College and took 2 wickets (for 39) out of the 4 wickets that fell for the day. In the third match Government College was beaten by 6 wickets by our team. The visitors who batted first were disposed of for 62 runs, S. Varadarajan was unplayable and bagged 6 wickets conceding only 12 runs. Our College had little difficulty in passing the visitors' total and cried halt when the score was 130 for 4. H. Shiva Rao played a polished innings before he retired with 41 runs to his credit. K. K. R. Menon and Narasinga Rao came up next with 29 and 21 runs respectively.

Tennis. This game as usual, is attracting a large number daily. Our College represented by Messrs. Sayed and Herbert beat the recruits school by 6—3 and

6—2. In the match with the Y. M. C. A., Sayed and Lakshminarayana won by 6—4 and 7—5. The Madras Engineering College which sojourned here on their way to Pykara played us in doubles. Three strings represented each College and our College won five out of 6 sets.

Manager's Note.

ERRATA

Vol. XXIV, No. 8, (August 1936)
Page 281, 9th line from the bottom.
For "T. V. Ramakrishna Iyer" Read "T. V. Rajagopalachari" and after "Jogiraju" add "G. Mahadevan."

Weather Review (AUGUST 1936).

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	8·5	+0·7	58 6
	Berhampore *	8·2	+0·3	44·8
	Calingapatam	7·7	-0·2	33·1
	Vizagapatam	5·3	-0·1	20·9
	Anakapalli *	4·5	-0·9	27·0
	Samalkota*	7·1	+2 5	37·4
	Maruteru *	9·0	+2·7	34·0
	Cocanada	7·6	+2·1	32·6
	Masulipatam	6·1	-0·8	31·5
	Guntur*	4·0	-1·0	28·8
Ceded Dists.	Kurnool	1·9	-3·1	12·3
	Nandyal *	3·3	-1·9	17·2
	Hagari *	1·0	-1·3	7·6
	Bellary	4·2	+1·9	7·4
	Anantapur	0·8	-1·4	6·4
	Rentachintala	3·7	—	15·1
	Cuddapah	1·2	-4·6	9·4
	Anantharaju-pet *	1·0	—	—
Carnatic	Nellore	1·2	-2·1	8·8
	Madras	6·0	+1·4	17·7
	Palur *	4·4	-0·9	17·2
	Tindivanam *	4·3	-0·7	14·7
	Cuddalore	2·7	-2·3	11·9
Central	Vellore	1·8	-4·5	10·1
	Salem	5·7	-1·1	26·3
	Coimbatore	1·7	+0·6	11·4
	Coimbatore Res. Inst. *	1 9	+0·9	11·2
	Trichinopoly	0·0	-3·8	12·1

Division	Station	Actual for month	Departure from normal @	Total since January 1st
South	Negapatam	2·7	-0·9	16·3
	Aduthurai *	2 6	-0·2	14·8
	Madura	0·7	-3·6	13·7
	Pamban	0·3	-0·4	5·8
	Koilpatti *	0·4	-1·4	9·3
	Palamkottah	0·0	-0·6	12·2
West Coast	Trivandrum	3·1	-1·0	44·4
	Cochin	11·7	-1·2	85·0
	Calicut	18·2	+2·6	111·9
	Pattambi *	13·7	-2·0	84 6
	Taliparamba *	22·4	-5·9	108·3
	Kasargode *	23·2	-1·4	135·2
	Nileshwar*	23·9	-2·3	122·6
	Mangalore	23 9	+1·4	129·7
Mysore and Coorg	Chitaldrug	1·2	-1·8	7·5
	Bangalore	2·4	-3·1	18·2
	Mysore	3·0	-0·4	22·3
	Mercara	28·1	+2·6	131·5
Hills.	Kodaikanal	4·4	-2·6	29·2
	Coonoor*	2·6	—	37·7
	Ootacamund *	4·1	-2·7	34·9
	Nanjanad *	4 8	-2·0	36·4

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Both the Arabian sea and Bay of Bengal branches of the monsoon remained active during the first week of the month causing wide spread rain in the United Provinces, Central India, Central Provinces and Malabar. After this period the Arabian branch of the monsoon weakened and continued to remain so till about

the 17th when, a depression formed in the Bay of Bengal off the Orissa coast. This depression temporarily strengthened the monsoon in the Peninsula till about 20th after which period it became again weakened and remained so during the rest of the month. Three depressions caused the Bay of Bengal branch of the monsoon to remain fairly active and vigorous. A depression off the Orissa coast on the 28th caused a strong monsoon in the North Madras coast but this was not able to influence weather conditions in the rest of the Peninsula.

Rainfall was normal or in moderate excess in Circars and was generally in defect in West Coast, Ceded districts, South Madras and Mysore.

Weather Report for the Research Institute Observatory.

Report No. 8/36.

Absolute maximum in shade	90·0 F.
Absolute minimum in shade	66·5 F.
Mean maximum in shade	85·8 F.
Departure from normal	−2·1 F.
Mean minimum in shade	71·2 F.
Departure from normal	−0·5 F.
Total rainfall for the month	1·93"
Departure from normal	+0·94"
Heaviest fall in 24 hours (Recorded on 6—8—36) ...	1·25"
Total number of rainy days	4 days.
Mean daily wind velocity	5·3 M. P. H.
Mean humidity at 8 hours	73·9%
Departure from normal	+0·6%

Summary. The maximum and minimum temperatures were below normal. Rainfall was in excess by 0·94". The skies were moderately to heavily clouded. Humidity was slightly above normal. Dry weather conditions prevailed in the last week of the month.

P. V. R. & D. V. K.

ADDITIONS TO THE LIBRARY

JULY 1936

A. Books.

1. Soya bean. *Kale, F. S.* (1936). 2. The World Sugar Problem, 1926-1936. *Gutierrez, V,* (1935). 3. Garden Science. *Grainger, J.* (1935). 4. Your Flower Garden. *Day, H. A.* (1936). 5. Gardening in Towns. *Thomas, H. H.* (1936). 6. Modern Fruit Growing. *Seabrook, W. P.* (1933). 7. Back to the Land. *Orwin, C. S. & Darke, W. F.* (1935). 8. A Course of Study in Managing a Farm. *Lowark, A. T.* (1931). 9. Agrarianism: A Program for Farmers. *Cauley, T. J.* (1935). 10. Modern Production among Backward Peoples. *Graves, I. G.* (1935). 11. Labour in Agriculture. *Howard, L. E.* (1935). 12. Co-operation and the New Agricultural Policy. *Horace Plunkett Foundation Pub.* (1935). 13. Agricultural Education in Europe. *Int. Inst. Pub.* (1935). 14. Transactions of the Third International Congress of Soil Science, Vol. 3. (1936). 15. Humus. *Waksman, S. A.* (1936). 16. Milk Production and Control. *Harvey, W, C. & Hill, H.* (1936). 17. The World's Hand Book of Dairying. *Murray, A. H.* (1936). 18. Dairy Cow Testing Throughout the World. *Int. Inst. Pub.* (1935). 19. The Poultry Keepers' Text Book. *Brown, E. T.* (1934). 20. Elementary Veterinary Science for Agricultural Students. *Thompson, H. & Duncan, A. C.* (1935). 21. The Beginnings of Plant Hybridization *Zirkle, C.* (1935). 22. The Cultivated Races of Sorghum. *Snowden, J. D.* (1936). 23. Die Fusarien. *Wollenweber, H. W. & Reinking, O. A.* (1935). 24. Plant Viruses. *Smith, K. M.* (1935). 25. Essentials of Physiological Chemistry. *Anderson, A. K.* (1935). 26. Bee Keeping (I. C. A. R. Misc. Bull. 6). *C. C. Ghosh.* (1936). 27. Embryology and Genetics. *Morgan, T. H.* (1934). 28. Practical Zoology. *Hewer. H. R.* (1935). 29. Flour Milling Processes. *Scott, J. H.* (1936).

B. Annual Publications and Reports.

1. Symposia on Quantitative Biology, Vol. 3. (1935). 2. Annual Review of Biochemistry, Vol. 5. (1936). 3. Scientific Reports of the Imperial Institute of Agricultural Research, Pusa for 1933–34. 4. Report of the Agricultural Department, Bihar and Orissa for the Period from the 1st April 1934 to the 31st March 1935. 5. Annual Administration Report of the Department of Agriculture H. E. H. the Nizam's Government for the Year 1342 Fasli (6th June 1932 to 5th June 1933). 6. Report of the Fifth Horticultural and Poultry Show, 1935. 7. Report on the Administration of the Department of Agriculture and Fisheries, Travancore for the Year 1110 M. E. (1934–1935 A. D.). 8. British South Africa Mazoe Citrus Experimental Station Annual Report for 1934. 9. Kenya Colony and Protectorate Department of Agriculture Annual Report, 1934, Vol. I. 10. Kenya Colony and Protectorate Department of Agriculture Annual Report, 1934, Vol. II. 11. British Cotton Growing Association 31st Annual Report for 1935. 12. Transactions of the Highland and Agricultural Society of Scotland Fifth Series, Vol. 48. 13. Massachusetts Agri. Experiment Station Annual Report for the Year ending November 30, 1935. 14. Annual Report of Director of New Hampshire Agricultural Experiment Station for the Year 1935. 15. Annual Report of the Director of Extension Service for 1935. New Hampshire. 16. United States Agri. Dept. Bureau of Plant Industry Annual Report 1935. 17. United States Agri. Dept. Soil Conservation Service Annual Report, 1935. 18. United States Agri. Dept. Bur. of Agri. Economic Annual Report, 1935, 19. United States Agri. Dept. Bur. of Agri. Engineering Annual Report, 1935. 20. United States Agri. Dept. Bur. of Animal Industry Annual Report, 1935.

C. Special Reports and Publications.

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Departmental Notifications.

Appointments. The following appointments are ordered by the Director of Agriculture, Madras. M. R. Ry. K. Minakshisundaram to officiate as Assistant in Cotton Section, vice Mr. N. Kesava Iyangar on leave or until further orders to report himself for duty to the Superintendent, Dry farming station, Hagari. M. R. Ry. K. M. Narayanan to officiate as Farm Manager, A. R. S., Taliparamba till further orders in an existing vacancy to report himself for duty to the F. M., A. R. S. Taliparamba; M. R. Ry. V. V. Rajagopalan to officiate as Assistant in Oil Seeds Section till further orders in one of the temporary posts sanctioned in G. O. No. Mis. 494 development dated the 27th March 1936 to report himself for duty at the A. R. S, Kasargode; M. R. Ry. P. C. Sahadevan to officiate as Assistant in Paddy until further orders vice Mr. N. Parthasarathi granted leave, to report himself for duty to the Superintendent, A. R. S. Pattambi, forthwith.

Transfers. M. R. Ry. M. K. Venkatasubramaniam, Assistant in Paddy, A. R. S. Pattambi is transferred to Coimbatore; M. R. Ry. Tirumala Rao, W., Offg. Assistant in Chemistry, Coimbatore to A. R. S., Anakapalle; M. R. Ry. F. L. Daniel Offg. Assistant in Chemistry, A. R. S, Anakapalle to Coimbatore; Agricultural Demonstrator, Cocanada to be in additional charge of Tuni sub circle; Mr. T. Ramanujulu Naidu, Upper subordinate under training will be under the A. D. Cocanada; Agricultural Demonstrator Bhimavaram will be in additional charge of Narasapur sub circle until further orders; Mr. P. Seetharamia, Upper subordi-, nate under training is transferred to Kovvur to be under A. D., Kovvur; Mr. M. L. Balasundaram, Offg. F. M., A. R. S. Maruteru, is appointed to officiate as Assistant in Paddy at the same Station vice Mr. C. Venkatasaravayya Chetty on deputation under the Imperial Council of Agricultural Research; Mr. V. V. S. Varadarajan, A. D., Bezwada is transferred to the A. R. S., Guntur as Farm Manager in place of Mr. A. K. Annaswami Iyer transferred to Hosur; Mr. M. Vaidyanathan, Assistant in charge of Dry Farming Experiments in Anantapur district is tranferred as A. D., Hindupur; Mr. S. Krishnamurthi Rao, probationary Farm Manager, Dry farming station, Hagari is transferred as Assistant in charge of Dry Farming experiments in Anantapur district vice Mr. M. Vaidyanathan; Mr. A. R. Krishnamurthi Iyer, A. A D. Peravurani to Orthanad; Mr. R. Kolandavelu Nayacker, A. D., Orthanad to Peravurani; Mr. P. K. Natesa Iyer, A. D., Srivilliputhur is transferred to Manamadura on the expiry of his leave. He will take charge of that sub circle from the A. D., Ramnad.

Leave. M. R. Ry. U. Vittal Rao, L. A. P. for 2 months from the date of his reversion to the Madras Agricultural Subordinate service.—M. R. Ry. J. David, A. A. D. (Microtome section) L. A. P. for one month from the 15th September 1936 with permission to avail the holiday on the 15th October 1936. M. R. Ry. C. A. S. Ramalingam Pillai, A. A. D., Manamadura extension of L. A. P. on M. C. for 2 months in continuation of the leave already granted.

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Editorial.

Live-stock improvement. Ever since the Viceroy gave an impetus to the improvement of animal husbandry in India by presenting three pedigree bulls for free service in the Delhi District, many local boards and big land owners have come forward with commendable promptitude to maintain breeding bulls in several parts of the country. The Advisory Board of the Imperial Council of Agricultural Research have also arranged to constitute an animal husbandry bureau, to collect information regarding special characteristics of seven best breeds of cattle, and to open and maintain an official herd book for the registration of the performances of the pedigree cows. Besides several press notes by the Director of Public Information, Simla, and addresses by the Live-stock expert attached to the Imperial Council of Agricultural Research are being broadcasted from time to time with a view to educate the public on the importance of the development of live-stock. All these activities have gone a great way in encouraging one important aspect of animal husbandry viz. breeding.

If this impetus is to be kept up and if all the efforts taken so far are to be fruitful, it is extremely essential that arrangements should be made on an adequate scale for the rearing and maintenance of the progenies of pedigree animals. It has to be remembered at the same time that improved live-stock require feeds of higher nutritive ratios

for their maintenance than the low grades, and that a large proportion of the fodders raised under the Indian conditions on soils with low fertility and with no manure has a poorer nutritive value than those grown elsewhere. Naturally the maintenance of improved breeds will involve greater attention on the part of farmers with regard to the provision and choice of forage for them. They will then have to resort to a more extended use of concentrated foods like oilcakes to make up for any deficiency. Not only does this often prove much beyond the means of the average cultivator but even to those who can afford it. The low price which the most carefully tended animals fetch in the fairs and the lack of adequate demand for milk and its products in most of the villages especially those situated away from towns, prove deterrant. The condition of the calves of such a valuable breed as the Ongole that are being paraded daily by the milkmen in towns like Madras. and the practice obtaining in certain districts, of baling out water for irrigation from fairly deep wells by means of piccotahs when bullock power can be employed for the same purpose with greater profit, bear ample testimony if any is needed, to the unremunerative nature of cattle feeding.

Nutrition researches started by the Imperial Council of Agricultural Research and the local Governments have thrown much light on the importance of minerals in feeding, on the causes of malnutrition and on the methods of remedying the defects in cattle. They have not, however, reached a stage to recommend the adoption of a particular feeding standard which will keep them in condition without making any inroad on the slender purse of the farmers.

The Royal Commission on Agriculture recognised the importance and hugeness of this impediment in the progress of animal husbandry in India, and declared in no uncertain terms that 'no substantial improvement in the way of breeding is possible until cattle can be better fed' and that 'in general the rule that increase in production must be preceded by the increase in the food supply holds good'. It is on this fundamental consideration they have made a number of recommendations with regard to the provision and improvement of grazing grounds, the ensiling of crops and grasses, methods of improving coarse fodders, feeding cows during dry period, and the restriction of the number of animals to be kept by the farmers. Much headway has not yet been made in many of these proposals since the publication of the Commission's report. As such we feel that the exhortation made by Col. Olver the other day in his broadcast address that he feels 'that it should be the sacred duty for every good cultivator, of whatever creed, to keep at least one good cow, feed her and her progeny well under the stall-fed conditions—which all progressive countries have been forced to adopt—and to mate her with a good bull of her own breed and type' will fall on deaf ears.

In this connection we wish to draw the attention of the readers to the proposals recently made by the Minister of Agriculture and Fisheries, United Kingdom, for safeguarding the beef industry of Great Britain. He indicated that "the Government propose to proceed on the basis of a regulated market with the maximum supplies to the consumer consistent with a reasonable level of remuneration for the producer. The Government have given earnest consideration to the position of the United Kingdom cattle producer under this arrangement and they propose to invite Parliament to make provision for a permanent scheme for the payment from the Exchequer of a subsidy to producers of fat cattle in the United Kingdom which while not stimulating as artificial expansion of the home industry will continue so long as and to the extent, that the situation may require". He has also announced that sums not exceeding £ 5,000,000 per annum would be set apart for the above purpose.

We venture to think that if the public are to respond adequately to the call of the Viceroy, an action on the part of Government somewhat along these lines is urgently called for. We would for instance recommend a considerable reduction in railway freight on bulky as well as concentrated foods, free distribution of grass seeds, encouragement of enclosing pasture lands either by remissions or by granting permission to divert the village panchayat funds, and offering subsidies to persons rearing good cattle and maintaining surplus stock in proper condition. If necessary a small cess may be levied on the import of dairy products and also on the export of edible oil cakes the annual values of which assume an enormous figure of 80 and 182 lacs of rupees respectively. We wish also to mention that the bulk of the consumers of the imported dairy products, coming as they do from richer classes, will least feel the strain of the imposition of the suggested tax.

We have dealt at some length with the collateral aspects of animal breeding in as much as we feel that they are of vital importance to livestock industry. We feel sure that the present Viceroy who was the Chairman of the Royal Commission on Agriculture will not leave any avenue unexplored to cheapen the cost of cattle foods and thereby link up the development of animal breeding with that of fodder supply not only with a view to implement the recommendations of the Commission, but also to see that his first act of love in India is placed in a suitable environment as to develop and unfold all its potentialities to the benefit of the agriculturist.

STUDIES ON THE EFFECT OF ARROWING IN CANES UNDER COIMBATORE CONDITIONS

BY K. KRISHNAMURTHI RAO, Dip. Agri.,

Assistant Sugarcane Expert, Imperial Sugarcane Station, Coimbatore.

Introduction. In and around Coimbatore sugarcanes begin to arrow in October—November. It is not known why certain varieties arrow, while others do not. There is a certain amount of prejudice in these parts against arrowing. From what follows it will be seen that arrowing is really a disadvantage in many respects in these parts.

The work described herein is part of an investigation published elsewhere jointly with Mr. K. V. Gopala Iyer. Additional corroborative data and some new facts since obtained on the subject are now given.

Material and Methods. Sampling was done on a fairly large scale. For every analysis, eighteen clumps were taken at random from different plots giving from 70 to 100 canes per analysis. A few arrowed canes were selected and labelled in the field, and periodical measurements of the total length of cane from the ground level were recorded to find out the growth, if any, in the arrowed canes. For sectional analysis, the dead leaf portions of the canes were cut into three sections and analysed separately.

Results. *Growth* :—When once a cane arrows there is no fresh nodal formation, but only a slight elongation in the top joints as will be clear from the following table :—

Table I.

Height of the canes from the ground level up to the joint just below the attachment of the sheath of the shot blade.

Co. 290		Co. 223	
30—11—1935	16—12—1935	30—11—1935	16—12—1935
4 ft. 11½ in.	5 ft. 1 in.	5 ft. 8½ in.	5 ft. 10½ in.
4 „ 8½ „	4 „ 10 „	6 „ 9 „	6 „ 9½ „
5 „ 8½ „	5 „ 11½ „	6 „ 0 „	6 „ 1 „
5 „ 7 „	5 „ 8½ „	5 „ 6¾ „	5 „ 8¾ „
5 „ 5 „	5 „ 6½ „	5 „ 7 „	5 „ 8½ „
5 „ 3½ „	5 „ 6½ „	6 „ 11 „	6 „ 11½ „
5 „ 7½ „	5 „ 9½ „	5 „ 0 „	5 „ 2 „
6 „ 3½ „	6 „ 5½ „	5 „ 8¼ „	5 „ 11 „
Average increase about 2 ins.		Average increase about 1½ ins.	

The greater increase in the length and weight of cane after the shot blade stage is only in the millable part of the cane as the joints that were not fit to be milled when the cane was in shot blade become fit to be milled in the course of one or two months.

The non-arrowed canes, on the other hand, grow continuously and weigh at harvest more than 1½ times the maximum weight

attained by the arrowed canes. The sucrose contents also equal and even slightly excel the maximum reached by the arrowed canes.

Table II.

Average maximum weight of millable cane and maximum Sucrose per cent in juice.

	Co. 290		Co. 422	
	Arrowed.	Non-arrowed.	Arrowed.	Non-arrowed.
Maximum weight	1·6 lbs.	2·3 lbs	2 2 lbs.	3 9 lbs.
Maximum sucrose	16·68 %	17·25%	19·16%	19·57%

Yield of sugar :—At the time of arrowing, the yield of sugar from 100 canes is more in the arrowed canes than in the non-arrowed canes. After about 2½ months there is deterioration in the arrowed canes, while the non-arrowed canes continue to improve. Consequently, there is a distinct loss due to arrowing at the usual time of harvest, as is clear from the following graph.

Sectional analysis :—The sectional analysis up to the dead leaf joints of a large number of arrowed and non-arrowed canes are given below :—

Sugar Yields at different periods in Arrowed versus Non Arrowed Canes.

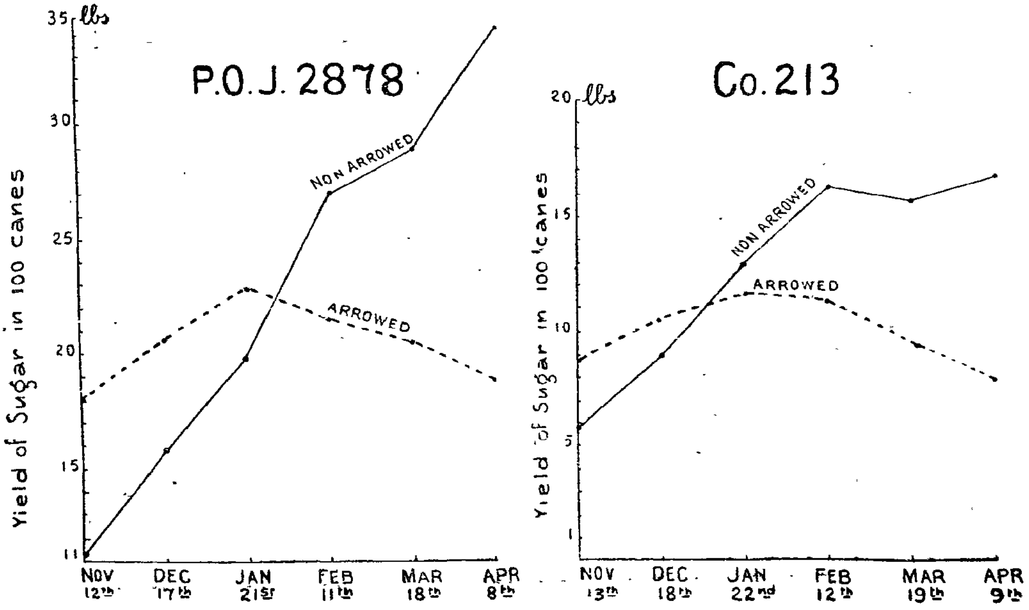

Table III.

Inorease of Sucrose Content in the Dead Leaf Portions.
Non-arrowed (Co. 422).

Date of analysis.	Top.	Middle.	Bottom.	Full millable cane.
18-12-1935	14·44%	14·87%	15·66%	12·08%
8-1-1936	14·90%	15·10%	16·53%	13·95%
25-1-1936	16·37%	16·91%	17·05%	15 62%
12-2-1936	18 29%	18·61%	18·62%	17·03%
11-3-1936	19 99%	20·22%	20·43%	19·50%

Arrowed (Co. 290).

Date of analysis.	Top.	Middle.	Bottom.	Full Millable cane.
17-12-1935	14·77%	15·68%	16·53%	15·57%
9-1-1936	16·18%	17·63%	18·16%	16·20%
20-1-1936	15·49%	17·81%	18·60%	16·68%
11-2-1936	14·65%	17·66%	18·48%	16·34%
7-3-1936	14·28%	16·79%	17·96%	15·72%
25-3-1936	14·03%	16·17%	17·49%	15·22%

Although the data in the above table refer to two cane varieties, a similar phenomenon was observed among non-arrowed and arrowed canes in the same variety. It is seen that in the non-arrowed canes there is a considerable increase in sucrose content in all sections of the dead leaf portion from December to March, and that the highest sucrose content continues to be in the bottom section. In the arrowed canes, however, there is increase in the sucrose content till about the middle of January and then deterioration commences. This deterioration appears to be slightly more rapid in the top than in the bottom, thus making it almost impossible for the top sections to ever equalise in their sucrose content the bottom ones.

Green tops :—In the arrowed canes the green tops are not useful for fodder purposes, while in the case of the non-arrowed canes the green tops constitute about 1/6th to 1/8th of the total weight of a cane and are fit for feeding cattle. The actual weight of green tops obtained from different varieties is given below :—

Table IV.

Weight of Green tops obtained from 15 rows.

Variety.	Approximate percentage of arrowing.	Quantity of green tops obtained.
P. O. J. 2878	80%	184 lbs.
Co. 213	60%	270 lbs.
247 B.	20%	624 lbs.
Co. 402	Nil	857 lbs.

My thanks are due to Mr. K. V. Gopala Iyer for kind help rendered.

Summary and Conclusion. In an arrowed cane there is only a slight elongation in the top joints.

Arrowed canes deteriorate after about 2½ months from the time of arrowing, while there is continuous growth and steady increase in the sucrose content of the non-arrowed canes; consequently, there is loss due to arrowing.

Though arrowing is a distinct disadvantage in many respects, an arrowing, and quick growing variety will be found useful for early crushing by factories in November, when other varieties are not rich enough in sucrose.

Periodical sectional analysis of canes from top downwards on dead leaf samples has revealed that there is a steady improvement in sucrose content in all sections.

Arrowing involves a loss of green tops suitable for fodder purposes.

SOIL CONDITION AS AFFECTED BY CROPPING IN THE BLACK SOIL AREA OF THE TINNEVELLY DISTRICT

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&

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The ryot of the black soil tract of the Tinnevelly and Ramnad districts adopts usually the following rotation:— Fodder cholam (*Andropogon Sorghum*), Cotton, (*G. indicum gammie*), Cumbu (*Pennisetum typhoideum*), and Cotton; whenever cotton follows cumbu, the yield is normal, but it is depressed when coming after a fodder cholam crop. Actually the figures collected from 1905 onwards show that the yield of cotton after Irungu (the variety of cholam grown) is about 15% less than that after Cumbu. The results of an investigation of this phenomenon, carried out under a scheme financed by the Indian Central Cotton Committee, showed that the growth of fodder cholam tended to alter the physical condition of the soil. After the cholam crop, the soil often turns out in clods under the plough, cracks but little, and has been observed to be considerably less permeable than after cumbu. A search for the more obvious agencies such as depletion of moisture, soil exhaustion etc., having proved futile, it was surmised that the adverse alteration of soil condition induced by cropping was responsible for the poor yield of the subsequent cotton crop.

Change of soil condition, producing profound and striking effects on crop growth, is a phenomenon with which many agriculturists will

be familiar. In fact many of the cultivation practices in vogue in different tracts have been evolved through the ryot's experience of tract, season and water supply, to promote that soil condition which is most favourable for crop growth; and when for some reason or other, an apparently meaningless departure is made from the cultivation practices, it has resulted in poorer crop-return. In the Godavari and Tanjore deltas for example, it is usual after the harvest of paddy, to leave the land fallow during summer without any preliminary cultivation whatsoever, and to take up puddling only after the receipt of rains. In Godavari, attempts on the part of the ryots to raise sugar-cane oftener than once in three years (as is the usual rotation) has entailed the crowbaring or ploughing of the soil after paddy. This has resulted in the soil becoming '*gulla*' or loose and crop growth on this kind of soil has always been poor. Similarly in Tanjore the effect of ploughing the field during summer has been to decrease the yield of paddy that season. A common feature of such phenomenon was an obvious change in soil texture which revealed itself in most cases in reduced rates of percolation or in the refractive behaviour of the soil under the plough and an explanation based on such changes appeared satisfying. The gulla soil, for example, was soft, sponge-like, cracked but little and was tenacious of moisture; so also in Tanjore, summer cultivation of the heavy illdrained soils "causes the cracks in the land to close, which stops all movement of water through the soil when the field is flooded." It should however be admitted that explanations such as these are mere records of observations and cannot be considered satisfactory and much less capable of leading to a control of the phenomena in question.

The only instance known to us for which a scientific explanation has been attempted is the one by Breazeale[1] in connection with the effect of sorghum on the succeeding crop. Breazeale was inclined to attribute the changed condition of the soil to a decrease in available carbondioxide, which again was attributed to reduced bacterial activity. It is not possible to discuss all his arguments here. It may be stated, however, that the theory advanced is not based on direct experimental facts.

In view of these observations, the work reported in this paper, should be of great interest; for experimental work on the Koilpatti soils has thrown considerable light on the probable causes that are responsible for altering the soil condition and their mode of action.

Experimental results. The experimental investigation was mainly along two avenues, which are detailed below in brief.

(a) *Cationic composition of soils.* Samples of soil were drawn from plots cropped with cholam and cumbu, from successive depth-intervals of 6″ during several stages of the growth of the crop and

1. BREAZEALE: Jour. Amer. Soc. Agronomy (1934) 16, pp. 689—700.

were analysed for exchangeable bases. The results are given in brief in table I and are examined statistically in table I-A. It will be seen from the analysis of the data that all the three interactions are definitely significant showing that changes in the exchangeable sodium occur as a result of crop growth and that the extent of such changes is different with the different crops. The soil after Irungu has more exchangeable sodium than the soil after cumbu; further, with crop growth, the exchangeable sodium rises in the soil especially in the top layers of cropped plots; in a *fallow* plot the exchangeable sodium remained more or less constant when examined at various intervals during the season; but in the cumbu and Irungu plots the soda went on increasing from October when the crops were sown to February when the Irungu fodder was cut.

(b) *Variations in the total colloid content of the soils during crop growth.* Samples of soil were also drawn from the several layers at different stages of the crop with a view to find out if there are changes in total clay content. The results are shown in Table II. Here again it will be seen that there is an increase in clay content with the growth of the crop in the top layers of the soil.

Discussion. A good friable texture in a heavy soil depends for example, upon the clay particles being generally flocculated and gathered into little aggregates promoting tilth. Clays which are rich in calcium, are easily flocculated like this, and are least retentive of water; sodium clays on the other hand are more sticky, dry less readily and are more easily dispersed, and this is in fact the type of change observed in the condition of the Koilpatti soil when they are cropped with cholam. The increase in exchangeable soda, noted above i. e. in alkalinity, would, by itself, be sufficient to explain the deteriorated condition of the soil after cropping, as it is only too well known that alkaline soils possess in general a poor texture. Also, it is easy to understand why this increase in alkalinity should follow on cropping with the cereals. The black soil area of the tract contains at a depth of about 3 feet to 4 feet a layer rich in sodium salts and it is probable that when shallow rooted crops are raised, water is lifted from the lower layers as a solution of these salts, which then interact with the calcium soils and leave them more alkaline.

This would, however, mean that cropping in general tends to produce more and more of alkalinity in the surface soils and a logical consequence of such a hypothesis should be that, in general, these black soils should be becoming increasingly alkaline with cultivation, which certainly is not the case. On the other hand even the " cholam effect " is but a temporary phase and does not last for more than one season. The soils get corrected, usually during the period of the succeeding crop; often, a simple fallow, or even a droughty summer

proves sufficient. These observations would appear to indicate the need for formulating an easily reversible mechanism, as the cause of the injurious after-effects of the cropping.

In the gentle flats of the black soil area, the processes of soil formation appear to be much the same as what obtain in other clay flats like those of Sudan and Egypt. A consistent feature of these formations is the absence of any sharp changes in the profiles down to the kunkar layer. Extensive studies of similar profiles in those countries have pointed out that, due to the intermittently moist conditions, their tropical situation, and their heavy nature, a mixing up of the soils of the whole profile is an annual feature and mass transport of soil material (upwards probably in the ascending water columns and downwards through the cracks that these soils develop during summer) should be of common occurrence; this latter is in all probability the agency that corrects the temporary aberrations in soil conditions observed as a result of cropping. The increase in the clay content of the several layers of the soil with the growth of the cholam crop is in all probability due to such movements of colloidal clay *en masse* and sodium clay being the most mobile is likely to be the predominating constituent of such moving masses. This may also be an additional cause for the increased alkalinity induced by cropping.

Again the downward transport of the clay material thus brought up to the surface depends largely on the extent of cracking developed by the soils which in turn depends on the degree of alkalinisation. The cholam crop has been found to leave the soil distinctly more alkaline and therefore less liable to crack; in such a soil, this downward transport of the clay material on which depends its restoration to the original state should suffer considerable retardation and this is exactly what is found. These soils crack poorly and the yields of the succeeding cotton raised on them are reduced by 15 to 20 per cent.

Reference to the table I on the rise of exchangeable soda during crop growth, will show that while both cumbu and Irungu soils definitely show an increase over the fallow soil, the actual difference between cumbu and Irungu is but little, being about 1 to 2 milli-equivalents only, at each stage of examination.

Ratner[2] has shown that quite small changes in exchangeable sodium of heavy soils are sufficient to bring about appreciable changes in the physical behaviour of soils and it is probable that, while with the rise of soda in it also, the " after-cumbu " soil does not show any great changes in physical condition, the slightly greater rise in the " after cholam " soil is responsible for all the faults laid at its door suggesting thereby the existence of an optimum point, which, when exceeded, affects the texture considerably.

2. RATNER E. T. Soil Science (1935). Vol. *40* pp. 462—3.

Table I.

EXCHANGEABLE SODIUM

(in milli equivalents per 100 g. of dry soil)

Time of sampling.	Top 6 inches.			Second 6 inches.			Third 6 inches.			Fourth 6 inches.			Fifth 6 inches.		
	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow	Cumbu	Irungu	Fallow
Before sowing	3·96	3·94	2 24	3·03	3 13	2·97	3·20	4·48	3·74	14·44	14·94	15·05	14·99	17·19	15·61
Immediately after N. E. rains	6·60	7·30	3·24	8·59	10·35	4·53	9·12	9·82	4·50	10·02	12·99	13·32	15·70	20·09	17·17
At Shot Blade (Irungu)	8·71	10 78	3·89	7 74	9·85	4·70	9·50	10·37	5·12	10·74	13·84	13 67	15·82	19·53	16·89
After Harvest (Irungu)	8·96	11 14	3 96	8·14	11·26	4·91	8·97	11·02	5·64	10·68	13·86	13·94	15·86	19 78	17·21

Table I A.

Statistical Analysis of the Data in Table I.

	Degrees of Freedom.	Mean Variance	Value of Z= Found	Calculated. (P=·01)
Seasons	3	23·97		
Crops	2	51·35		
Layers	4	283·31		
Season X crops	6	3·58	1 043	0·650
Crops X layers	8	7·71	1·415	0·606
Layers X seasons.	12	9·28	1·509	0·554
Residual	24	0·454		

Table II

Clay Percentages at different stages of crop growth After Irungu set seed—soil,

	0 - 6"	6" - 12"	12" - 24"
Before sowing	39·17	40·46	41·55
At shot blade	41·67	41·17	41·98
After Harvest	46·83	45·59	46·54

Note: The figures are the averages of 3 samples for each at each stage.

Summary. Growing of fodder cholam in the black soil tract of the Tinnevelly District has been known to produce certain obvious changes in the physical condition of the soil which is probably the cause of the reduced yield of the cotton crop following cholam.

During the growth of the cereal crops of the tract, a rise in exchangeable soda as well as in clay content of the surface layers has been shown to take place, more in the case of cholam crop than in cumbu.

The probable cause of such rise and their relationship to the changes in the physical condition of the soil are discussed.

Acknowledgement. The investigation was carried out as part of a scheme financed by the Indian Central Cotton Committee, to which body, our thanks are due.

We are greatly indebted to M. R. Ry. V. Ramanatha Ayyar, Cotton Specialist, for his kind criticism and encouragement throughout and to M. R. Ry. R. Chockkalingam Pillai, Superintendent, Agricultural Research Station, Koilpatti, and Mr. S. Sundaram, Assistant, Madras Fodder Cholam Scheme for the drawing of the necessary soil samples at Koilpatti.

FRUIT SUCKING MOTHS ON TOMATOES AND THEIR CONTROL

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and

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Introduction. In July 1935, a crop of tomatoes was raised at the Insectary and it grew well for about 3 months in spite of occasional trouble from certain caterpillars. In October, however, with the advent of the fruits, large numbers of fruit sucking moths appeared and began to pay their attentions to the crop. Hiding by day under bushes and appearing on the scene under cover of darkness these destructive hordes of delicate creatures with pale green forewings and bright yellow hind wings became a menace to tomato culture. They pierced the fruits with their proboscis ; circular patches appeared at the place of feeding and rotting set in with the result that the fruits were utterly useless for human consumption. Taking advantage of the presence of these moths in large numbers detailed observations as to their habits were made and various remedial measures tried.

Life History and Habits of the Insect. Eggs are laid by the female moth on the leaves of a weed known as *Tinospora cordifolia* (சீந்தி கொடி.) The newly hatched cater-pillars feed on the tender

shoots and leaves of the plant. They grow in size and undergo a series of moults after which they spin together the leaves and line them with a fine texture of silk and then pupate. The life cycle of the moth from egg to adult is about a month, the egg, larval and pupal periods being 3, 18 and 9 days respectively. The caterpillars have an interesting habit of dropping down into the bushes when slightly disturbed which seems to be a method of protecting themselves from their enemies. A moth fed on jaggery water lived for 24 days but 12 days can be taken as an average life of the moth.

Two species of fruit moths (*Ophideres materna* and *O. fullonica*) of which the former predominated were noticed to visit the fruits. From a collection made in the field it was found that about 95% were *O. materna*.

As stated before, the moths hide during the day among the bushes and are active only after night fall. From 7 or 8 P. M. they commence their destructive activities and continue feeding till very late at night. A few of the moths have been noted to feed upto 4 A. M. Almost similar was the feeding habit of moths kept under captivity in the Insectary.

The moths show preference to ripe fruits but in their absence or when these become scarce they take to green or raw fruits also. The fruits on the top of the trellis are attacked first while the lower ones are taken up later. The fruits plucked and kept on the ground did not attract the moths at all.

A few observations were made on the power of flight of these moths. When the bushes adjoining the tomato plot were disturbed during day time a few moths were seen to rise in the air to about 200 feet and fly away in the direction of the wind and were lost sight of. When disturbed during night time also their quick flight was observed to some distance when they disappeared from view.

Fruits Affected by the Moth. The moths are known to feed in fairly large numbers on the fruits noted below:—

Names of fruits.	Places where the pest has been noted.
1. Batavian Oranges.	Samalkot, Pithapur (Godavary Dt.) Palacole, Nidadavole, Madumadinagudam (Krishna Dt.) Rajampet, (Cuddapah District) Panyam (Kurnool District)
2. Kamala Oranges.	Palacole, Nidadavole, Madumadinagudem.
3. Oranges.	Kallar, Sethumadai, Semmedu, Agricultural College Estate.
4. Guavas.	Agricultural College Estate.
5. Grapes.	,, ,,
6. Tomatoes.	Agricultural College and Tudiyalur.
7. Bilimbi.	Kallar.
8. Cashew.	Kallar.
9 Mango.	Palacole, Nidadavole, Madumadinagudem.
10. Pomegranate.	,, ,, ,,
11. Cactus.	Agricultural College Estate.

Nature and Extent of Damage to Tomatoes by the Moth. The moths by means of their proboscis. puncture the fruits and feed on the sap. After feeding, the juice oozes out and the very next day after infestation the characteristic 'hollow' is seen and rotting sets in which extends during the next two or three days. The fruits become baggy and get shrivelled up. Unlike oranges the tomato fruit does not drop down to the ground as a result of the attack of the moth. If the moths attack the green fruits close to their stalk then some of them may drop. In nature, the same fruit may be punctured by more than one moth during different nights but one puncture is enough to spoil the fruit. Sometimes as many as five moths have been noticed feeding on a single fruit. On a modest estimate, at least 50% of the fruits were damaged during the season.

Trials of Remedial Measures. Several control experiments were conducted during the last season and a good deal of valuable information added.

Light traps: Bright mantle lights put up in the field to see whether moths had any attraction to lights gave negative results. Coloured lights such as blue, green, yellow and red had also no attraction for the moths.

Small traps: Ripe tomatoes cut open and smeared with molasses mixed with arsenate solution and Amyl acetate also did not attract the moths.

Poison baits: Plantains impregnated with a sugar solution of Sodium arsenate were hung by means of strings along with ripe tomato fruits. The baits were put out in the evening and removed in the morning. A few moths were noticed to feed on the bananas but no special preference to these fruits was noticed.

Experiments in the Laboratory showed that moths fed on poisoned bananas died within 12 to 36 hours after feeding. Other less costly fruits and those that can be got practically free will be tried during the next season.

Spraying of deterrents: Of all the deterrents tried, Crude oil emulsion was the best but even here the repellent action lasted only for three days and from the fourth day onwards the moths came in numbers to feed on the fruits. Spraying deterrents once in four days is not an economic proposition, especially in the case of tomatoes.

Destruction of adult moths: In the course of the experiments it was found that a bright light brought near the moths suddenly while feeding, stupefied them and made them unable to fly. This was taken advantage of and in this way hundreds of moths were captured and destroyed. As the crop does not grow high this method was very easy to practise. This, together with the eradication of the larval food plants *Tinospora* alone can be recommended against these fruit pests.

One other observation made during last year deserves mention in this connection. In the Central Farm Orchard where Batavian oranges and tomatoes were grown side by side, the moths showed distinct preference to tomatoes as against oranges. There was practically no attack on organges as long as the tomato crop was in the field but when this was pulled out in October the moths began to pay their attention to oranges. If these observations are confirmed by this year's studies we will have a cheap and effective remedy against this very serious pest of oranges in almost all fruit growing areas in this Presidency, i. e., growing tomato as a trap crop in such a way that the fruiting season may coincide with that of citrus so that the moths which are attracted to them may be captured and destroyed. We would request the district staff to give this a trial and let us know the results.

AN AFRICAN *RAGI*, ELEUSINE CORACANA GAERTN.—THE FINGER MILLET—WITH A VIOLET PURPLE COLOUR

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In a previous article (Rangaswami Ayyangar and Krishna Rao, 1931) three major types of purple pigmented plants have been described and their inheritance worked out. They are Purple, Dilute Purple and Localised Purple. In a subsequent article (Rangaswami Ayyangar, et al., 1933) a fourth type, Medium Purple was described. The mode of inheritance of all these types of Purple has been given. Factors P, I_1, I_2, H_1 and H_2 are involved in the above. The commonest type of Purple Pigmented Ragi is of the genetic constitution $P = I_1 \; I_2 \; H_1 \; H_2$.

This article describes a fifth type of purple, viz., Violet Purple, and the mode of its inheritance. This Violet Purple was first met with in an African variety from Nyassaland. It was noticed that the plants had a tint of violet and were coloured deeper than the usual purple plants. Not being very vigorous, this purple was suspected to be a type of distress purple that would disappear with acclimatisation. Type plants were carried forward and it was noticed that even the next year the same tint of violet with the same un-economic growth existed. It was found that this type of purple manifested itself in all the places at which the normal purple manifests, with this difference that in the glumes the violet tinge added to the prominence of the purple. In the amount of purple this new type and the ordinary Indian type are about equal, only they differ in the quality of the same, which in the African type takes on a violet tinge so that the new type can fittingly be designated Violet Purple. The absence of this type of

Purple in the wide ragi-growing areas of this presidency coupled with the comparatively un-economic nature of this Violet Purple variety makes it probable that the dropping out of the dominant gene responsible for its presence, marks one of the stages in the evolution of the more recent and economic cultivated varieties. The lingering of this type in a part of Africa is therefore interesting in throwing light on the origin and affinities of the finger millet.

The relationship of this type of purple to the others:

(A) Purple,
(B) Medium Purple,
(C) Dilute Purple,
(D) Localised Purple,

and (E) Green (non-purple pigmented)—allelomorphic to P—was pursued and suitable crosses made. In every case the F_1 was a Violet Purple. The following segregations occurred in the F_2 generation.

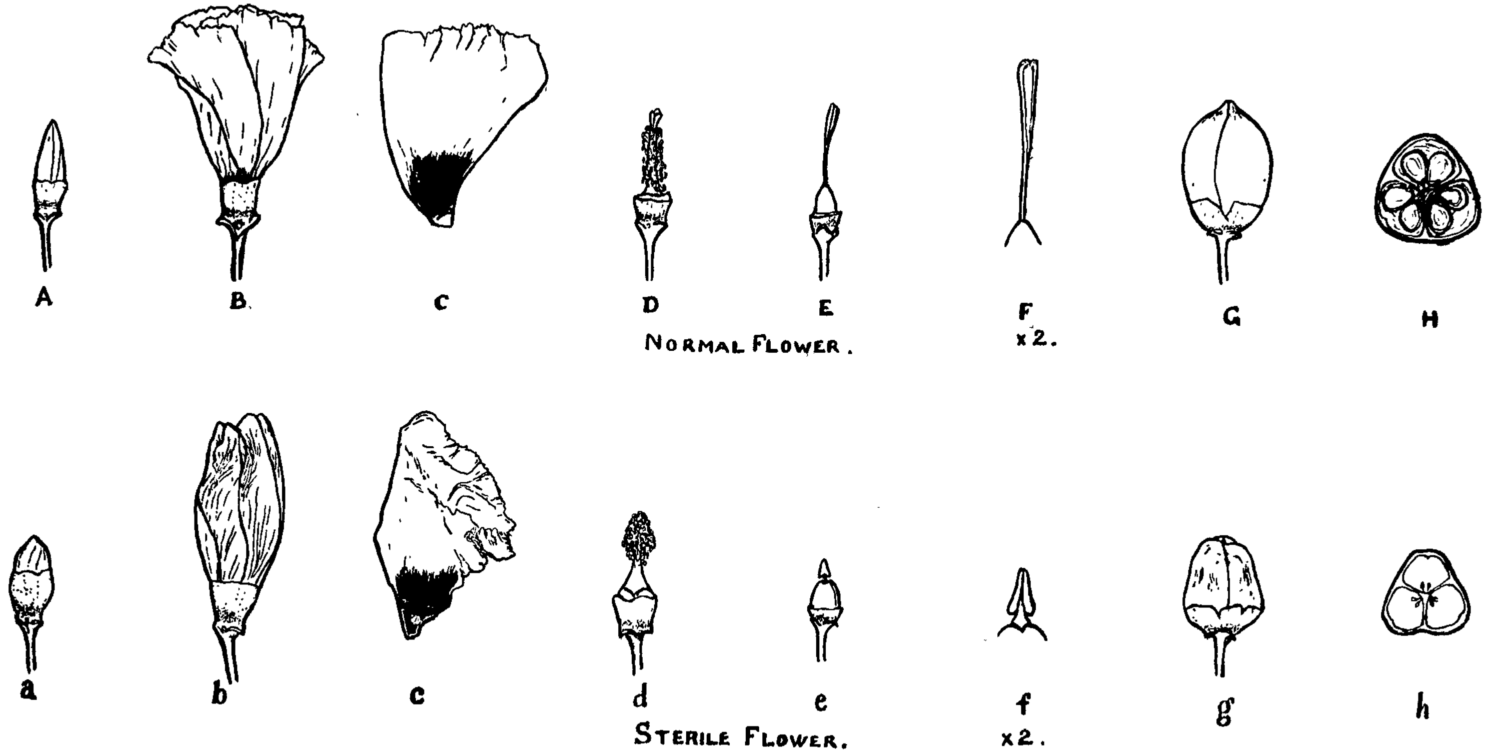
Nature of the crosses.	Generation.	No of families studied.	No of plants obtained in: Purple		Medium Purple		Dilute Purple		Localised Purple	Green	Nearest theoretical ratio.	Value of P.
			With Violet	Without Violet.	With Violet	Without Violet	With Violet	Without Violet				
A. Violet Purple ×	F1		*									
Purple	F2	2	77	26							3 : 1	1
B. Violet Purple ×	F1		*									
Medium Purple	F2	1	112	27	7	4					45:15:3:1	>·1
C. Violet Purple ×	F1		*									
Dilute Purple	F2	2	158	70			65	20			9 : 3 : 3 : 1	>·2
D. Violet Purple ×	F1		*									
Localised Purple	F2	2	188	53					78		9 : 3 : 4	>·5
E. Violet Purple ×	F1		*									
Green	F2	2	142	44						71	9 : 3 : 4	>·3

The 9 : 3 : 4 ratio in (D) above has to be explained. This 9 : 3 : 4 is only like the others a 9 : 3 : 3 : 1 in which the end two groups are not easily separable owing to the poor manifestation of pigmentation, so that whether a Localised Purple has Violet or not is difficult to tell; so localised and light is this purple.

The existence of this Violet factor independently of the presence of the P factor has been demonstrated by designing crosses in which a number of non-pigmented plants picked out from (E) above were mated to a Localised Purple. As expected some of the crosses gave F_1 plants, Violet Purple. The least dose of Purple was enough to activate the latent violet in the Green.

It will thus be seen that a dominant gene designated *Vt* imparts a Violet tinge to purple and makes it Violet Purple. In its absence *vt* the plant is of the ordinary purple type. This dominant gene could be

FLORAL PARTS



super-imposed on every other manifestation of purple; only in the case of the Localised Purple its effect is feeble.

Summary. A dominant gene *Vt* found in African varieties colours the ordinary purple in the *Ragi* and makes it appear Violet Purple. *Vt* is a simple dominant to *vt* which is present in all local Indian varieties of *Ragi*. *Vt* could be detected in all grades of Purple, excepting Localised Purple on which its effect is feeble. It could be present in a Green (non-purple pigmented), lacking the factor P. The factor *Vt* is not conducive to economic growth under Indian conditions.

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A HERITABLE CASE OF FEMALE STERILITY IN HERBACEUM COTTON

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A type of female sterility was described in 1934 (Kesava Iyengar, 1934), occurring in a pure strain (No. 1281), of *Gossypium herbaceum, L.* grown at the Agricultural Research Station, Hagari. The inheritance of this phenomenon was pursued during 1934, 1935 and 1936. In this paper are presented the morphology and the inheritance of these sterile plants.

The sterile plant. The sterile plants are perfectly healthy throughout their life history. The size, shape and colour of the leaves are all normal. Differences between the normal and sterile plants can be recognised only from the flower-bud stage onwards. The buds of the latter are distinctly swollen at the base and rounded at the tip, while those of the normal flower are more pointed.

The opening of the corolla is noteworthy. In a normal cotton flower the corolla has a contorted æstivation. The flower buds open normally (under the conditions obtaining at Hagari) at 10 a. m. The petals gradually untwist and liberate their upper margins completely. The flower, on complete opening, presents a campanulate form with the staminal column prominently standing out in the centre. The stigmatic head protrudes through this column. The extent of protrusion of the stigma is a varietal characteristic. In the case of the sterile flowers the opening is modified considerably. As a rule,

the flowers do not open fully and liberate the petals freely. An examination of the petals showed that the margins of the adjoining petals get interlocked with the result that the lower part of the petal has a corrugated appearance and causes the base of the flower to swell. The above feature is perceptible even from the bud stage. The flower on opening has a characteristic appearance.

Actual measurements made to determine if the ratio—breadth of the petal/the length of the petal—is identical in the normal and sterile flowers, show that in the case of the normal flowers the ratio was 0·78 while in the case of the sterile flowers it was 0·96. Thus the sterile flowers have relatively broader petals.

The staminal column in the sterile flower is slightly shorter than that in the normal one, but the number of filaments is greater in the former. The normal flower on an average bears 54 staminal filaments while the sterile flower has 64 filaments. The pollen grains of the sterile flower are viable and readily put forth tubes when dusted on to normal stigmatic faces. The resulting bolls are to all appearances normal and contain viable seeds. Pistils of the sterile plants are remarkable in that they present several abnormalities. In the normal cotton flower all the three regions of the pistil are well developed. But in the sterile plant, the ovary alone is well developed and bears ovules. It is globular in shape. The carpels do not however extend to form a well developed style as in a normal flower. The style is about a tenth of a centimetre while the length of the normal one is 6/10 centimetre. The stigmatic head in the sterile flower is again not well developed with no hairs and secretions. It has three triangular faces and appears to perch almost directly on the ovary, lying completely hidden inside the andrœcial column. The result is that no pollen reach it even by chance.

Fresh and viable pollen were dusted on to the stigma of the sterile plant with a view to test its receptivity. The placenta was examined for the pollen tubes by staining with cotton blue in lactic-phenol. No tubes were observed. None of the artificial pollinations made between the normal pollen and the sterile stigma developed any bolls with seeds.

Parthenocarpy: In the sterile plants, some-times well developed bolls were formed. These were whitish in colour instead of being green and flat on the sides. The examination of the boll showed that it was only an enlarged ovary with shrivelled ovules in the locules. These bolls were found to shed after a fortnight.

Inheritance. Natural crosses were spotted in 1933 which were used for the study of inheritance of this character in the seasons 1934—1936. In 1934, 20 plants were selected from a segregating lot and the produce of these plants was sown in 1935. In the segregating families monogenic inheritance was noticed, normal behaving as

dominant. This behaviour was confirmed also by a further study of natural and artificial crosses during the season 1935 and 1936.

Table I

Nature of the cross.	Generation.	No. of families studied.	No. of plants in Normal.	No. of plants in Sterile	Nearest theoretical ratio.	Value of P.
Natural cross.	Probably 2nd	10	1416	435	3:1	> ·1
	,,	10	Pure			
	Third.	10	338	101	3:1	> ·3
	,,	7	Pure			

Table II

Nature of the cross.	Generation.	No. of families studied.	No. of plants in Normal.	No. of plants in Sterile.	Nearest theoretical ratio.	Value of P.
1281	Parent			*		
H. 1	do.		*			
$H_1 \times 1281$	F_1		6	—		
,,	F_2	18	947	309	3:1	> ·3
1281 X ($H_1 \times 1281$)	Back cross	5	125	123	1:1	> ·5
1281	Parent			*		
1200 A	Do.		*			
1200 A × 1281	F_1		3			
,,	F_2	8	459	173	3:1	> ·1
1281 × (1200 A × 1281)	Back cross	3	116	127	1:1	> ·3

Artificial crosses. Crosses were made by utilising the pollen of the sterile plants and dusting them on to the emasculated flowers of two pure strains (strains Nos. H. 1 and 1200 A) belonging to the *herbaceum* group, grown on the station during the season 1934. The F_1 plants were all normal in both the sets of crosses and exhibited none of the peculiarities characteristic of the sterile flowers. In 1936, some of the F_1 plants were sown. In all the selections, the segregation was monogenic in both the sets of crosses. (Table No. II).

Back-crosses were made between the F_1 plants and the sterile parent in both sets of crosses, during the season 1935 and the behaviour of their progenies was pursued in 1936. The expected 1:1 ratio was obtained. (Table No. II).

Discussion. The behaviour of the segregations in the natural crosses, observed during the two seasons shows, that only one factor is involved in the inheritance of the phenomenon in question. In the artificial crosses, the behaviour of F_1 shows that the normal type is completely dominant to the sterile. The behaviour of the F_2 progenies, and of the back crosses clearly denotes that only one factor

is at play and that the several attendant abnormalities described in the case of the sterile plants are the result of the absence of a single gene. A factor 'Stg' governs the manifestation of the normality of the ovary and its absence (stg) brings about a condition which leads to the sterility of the plant.

Summary.

1. The occurrence of a sterile plant is described.

2. Female sterility is found to be caused by the abnormal development of the style and stigma.

3. Parthenocarpic bolls develop sometimes on the sterile plants.

4. This type of sterility behaves as a simple Mendelian recessive to the normal condition of the flower which is completely dominant.

5. The pair of factors responsible for the above phenomenon are represented by Stg—stg.

Reference.

1. N. Kesava Iyengar (1934) *Mad. Agr. J.* 22: 152—153.

THE PRESENT POSITION OF STRAIN NANDYAL 14 IN THE 'NORTHERNS' AREA.

By L. NEELAKANTAN M. A.,

Cotton Assistant, Nandyal.

The cotton grower is worried. His crop has again fallen below expectation. He got his seed from the best shop in the bazaar. Yet, they say in the market that his stuff is as poor in quality as ever. The buyer does not prize it to his satisfaction. It is annoying in the extreme. He suspects that insects and diseases are partly responsible for his woes. Yet he instinctively feels that in spite of them his crop could do better, but he does not know. Something is wrong somewhere. He goes seeking for advice and happily meets the plant breeder. The breeder understands him and tells him that one reason as he could see from an examination of his crop is that his seed is impure, that is, it is a mixture of several races of cotton. He infuses hope into the dejected grower by saying that the difficulty can be overcome, and that ere long he will be having a crop which will not only be uniform with a fairly steady yield, but will also be valued highly in the market. The breeder sets to work accordingly. He labours for a time and succeeds in discovering what he calls a promising strain—from the local stock. The eager cultivator welcomes it, and is amazed to find it scoring high directly on being put on the market. Buyers rush up to him prefering his produce to others. All goes well with him, and he is carried on the crest of fortune, but only for a while. Soon a tide turns to his vexation. The demand goes down suddenly in the market, and the strain no longer fetches him more money than the original

bulk. The grower gets disheartened. The puzzled breeder who has been watching the whole show quickly adjusts his machinery of improvement to meet current urgent demands.

The above is in brief outline the story of the rise and decline of Nandyal 14 an improved strain evolved from a bulk cotton known to commerce as 'Northerns'. The term refers to the cotton grown annually in the Madras Presidency in the taluqs of Dhone, Kurnool, Nandikotkur, Nandyal, Allagadda and Koilkuntla in the Kurnool district, the native state of Banganapalle in the same District, Jammalamadugu and Proddatur taluqs in the District of Cuddapah, and Tadpatri taluq in Anantapur District. It covers a little over 3 lakhs of acres in extent, and enjoys a reputation for strength and texture, forming one of the chief commercial types of Indian cottons. Though it is recognized as class I according to the Liverpool definition, the crop is a heterogeneous population of several good and bad varieties. The produce as a consequence is a mixture tending to vary widely from year to year in lint qualities. A standard type which is botanically pure, uniform and highly valued in the market would be a great improvement over the local stock. With this object in view the Madras Agricultural Department took up work at the Agricultural Research Station, Nandyal more than 25 years ago. Special attention was bestowed on quality and after years of experimenting, the Department succeeded in isolating a type in the year 1918—now well known as Nandyal 14 (N. 14). With an average yield of 200 lbs. of seed cotton per acre, and capable of spinning to 40's, this strain is one of the few finest cottons at present available in India.

Efforts were then directed towards popularising the same. A number of seed farms was systematically organised. It was planned to get a supply of seeds in the course of a few years sufficient to cover the entire Northerns tract so that thereafter the same stock would be propagated year after year.

More than 15 years have gone by, which is a fairly long period for an improved variety to spread and assert itself, as has been the case of Co. 2 in the 'Cambodia' tract and H. 1 in the 'Westerns'. But N. 14 has failed to expand. At no time in the past has it spread to more than 8 to 10 per cent of the entire area. On the other hand there has been a distinct decline in its acreage. From nearly 30,000 acres in 1930—31 it has dwindled to 2,300 in 1935—36.

In looking out for factors contributing to this state of affairs, the first thing that strikes one is the possibility of a deterioration. But an examination of figures available at the Nandyal Farm shows that apart from fluctuation due to season there is no serious fall perceptible either in yield or lint length. Causes are to be sought for elsewhere.

The opinion of the grower is the best testimony to the capacities of a strain. The Nandyal ryot is not pleased with N. 14 for several

reasons. In the first place it has a low lint out-turn having a ginning percentage of 23, whereas the 'Northerns' bulk has a ginning value ranging between 25 and 28. The slight increase in seed cotton claimed for N. 14 on the basis of trials conducted on the farm is not borne out in the trials carried outside the farm. Again N. 14 lacks drought-resistant qualities, its performance coming up to expectation only in seasons of good rainfall. The ryots' bulk is hardier and more capable of standing seasonal vicissitudes. The red-leaf disease recently observed in the Nandyal cottons with its attendant sterility tending to detract from yield, is also present to a greater degree in N. 14 than in the bulk. Apart from these the high premia which this strain was realising—in some years it was paid Rs. 70 over the market rate—are not obtainable now and naturally N. 14 lost its glamour. Further it is found to thrive only in red and mixed soils.

All kinds of seed are being imported from outside every year. Bulk of these comes from Gadag, Dharwar and Bijapur in the Bombay Presidency and belongs to the commercial type known as 'Kumptas', (locally called as 'Gadag'). This importation of Gadag seed has been going on for several years in the past. Besides, Cambodia seeds from Tiruppur area, and H. 1 from the Westerns tract are also finding their way into this region. The component of the original Northerns possessing longer lint is being slowly swamped out. The crop now raised by the ryot is a mixture of all manner of varieties and is perhaps even more heterogeneous than the original Northerns. In quality, it is definitely inferior to N. 14 and is very varying from season to season depending upon its botanical composition. But this is not viewed with any great concern by the grower, as the extra yield is considered ample to compensate for any depreciation in the market value on this score.

To replace this mixture, a strain similar to N. 14 in quality but with a better yield and higher ginning percentage and more suited to a wider range of soil and rainfall conditions is what is needed. Recently attempts have been intensified in this direction at the Nandyal farm. But nature has, as it were, split up the two desired characters, namely yield and quality, such that when one is supreme the other is generally found to be low. The search for ideal type through the ordinary selection method thus becomes elaborate and is bound to be time consuming. During the last 10 years about 3000 plants from various centres of the tract were examined in detail, and yet a type better than N. 14 in all respects has not been found. This number however is a drop in the ocean of cotton material in the tract, and the isolation of a superior type is largely a matter of chance. It is something like casting nets in a big lake to catch the biggest fish available there. The desired catch may be quick or slow to achieve, and luck plays a great part. With patience and perserverance it is bound to come within the reach of even the unluckiest fisherman.

Recent attèmpts at the Agricultural Research Station, Nandyal, have succeeded in the establishment of three heavy yielding strains. Under the instructions of the Deputy Director of Agriculture, III Circle, Bellary, these are being tried for testing yield with N. 14. and ryots bulk in addition, in various centres of the tract with the co-operation of the Assistant Director of Agriculture, Kurnool. The trials are planned on up-to-date lines to allow of refined statistical interpretation of results and will be conducted for at least three consecutive seasons. The results of these trials are expected to give information also on whether Northerns tract is divisible into difinite zones with a particular strain suited to each zone. In such a contingency the produce that comes to the market will again be a mixture. But that need not cause alarm as such a mixture will be composed of types with similar spinning values and will go a great way in raising the name and standard of Northerns.

My thanks are due to the Deputy Director of Agriculture III Circle, Bellary for his kindness in offering me facilities in writing up this paper.

Selected Article.

Soil Crumb.* The most striking physical attribute of many fertile soils is their natural tendency to the formation of a crumb structure. This tendency is utilised by the farmer or planter in the production of a good tilth in his cultivations. Soil-tilth greatly contributes to the development of suitable water and air conditions which are of primary importance in the successful growth of the majority of crop plants.

Soil crumb cannot develop in soils entirely devoid of colloidal matter. Pure sand never forms crumb; its particles remain separated when the sand is dried, and settle into a closely-packed mass when it is wetted. At the other extreme, highly colloidal clays may only form crumb when certain conditions are realised. In the absence of these necessary conditions, clay soils merely crack into large lumps when dried, or "run together" into an impervious mass when wetted. The most suitable kind of soil for crumb formation is probably one containing a fair amount of colloidal matter in a suitable condition, together with a dilutant consisting of an assortment of grains of silt and sand of various sizes. The colloidal matter may be either inorganic (clay substance) or organic (humus). It possesses the ability of binding together the individual soil particles into aggregates and the aggregates into crumbs. In this way the soil assumes a characteristic and well-known structure, usually associated with high fertility.

It is imperative that the crumb structure developed in a soil by natural processes or by suitable cultivation should be stable. If the crumb be unstable, the soil tends readily to break down into its component particles, which then may be easily washed away by running water or blown about by wind. Such unstable soils suffer severe erosion, and their drifting frequently becomes a serious menace.

* **Acknowledgments** :— The subject matter of this article has been taken mainly from the recent writings of Dr. E. W. Russell of the Rothamsted Experimental Station, particularly "A Physical Description of Soil Tilth", Sands, Clays and Minerals, April 1936, Vol. II, No. 4, pp. 57—63.

Soils possessing no crumb structure at all exhibit a continuous pore-space distribution, which permits either air or water to move more or less freely through them, though air and water cannot each move freely if both occur together. When a stable crumb structure is developed, however, pore-space distribution becomes discontinuous. Although the pore-spaces within the individual crumbs may be continuous, cracks and spaces occur between the crumbs, so that there is sufficient room for the free circulation of both air and water around the crumbs. The finer pores within the crumbs may hold an appreciable amount of water which is available to plants even under fairly dry conditions. The larger cracks and spaces allow surplus water rapidly to drain away, and at the same time, they allow air and carbon dioxide to circulate freely, maintaining a high degree of aeration within the soil. The colloidal matter which binds the soil particles into crumbs also possesses the property of absorbing air as it dries. This air is liberated again when the colloidal matter is wetted but it becomes entrapped in the form of minute bubbles. Hence during temporary water logging, the colloidal matter provides a source of oxygen for plant roots, thus preventing asphyxiation.

The mechanism of crumb formation, and the precise factors which confer stability on the crumb are not yet completely understood, although they are being actively investigated in certain research institutes, notably the Rothamsted Experimental Station in England. It is known that the primary requisite for crumb formation is that the soil should first be wet, and that the water in it should then be removed at a certain rate. Water removal may be effected either by direct drying or by freezing. Frost is perhaps the most effective natural known agent for producing crumb structure and a good soil-tilth. In northern countries, clay lands are roughly ploughed in the late autumn, so that as large a surface as possible is exposed to the action of frost when winter comes. In countries where no winter is experienced, the alternative process of direct drying is utilised for producing a tilth. The land is ploughed into large clods during the early part of the dry season, and these are allowed to dry out during the following months. When the first rains come, the land is cultivated, and the shattered lumps then break down into crumbs The mechanism of this action is probably attributable to the liberation of entrapped air during the wetting process. The air forms holes and channels within the clods, which consequently become mechanically weaker and shatter readily under the action of the plough and the harrow.

A third method is often practised in countries where frost is unknown, and particularly if the soil lacks organic matter. It consists in the growing of heavy grass crops or vigorous leguminous plants, whose rootlets hold the soil particles together, and thus impart a crumb structure to the soil. The incorporation of bulky organic matter into the soil furnishes a supply of colloidal matter, which will confer a crumb-forming ability when the soil lacks colloidal clay.

The particular size of crumb most suited to the crop depends partly on climatic conditions. In humid climates, the chief need is an adequate air supply to the roots, so that an open structure is best, and the crumbs should therefore be of relatively large size. In arid regions, on the other hand, water is usually the limiting factor, so that a close compact structure is best, and the soil should have a fine crumb structure conducive to water conservation. For the best results, the size of the soil crumbs should range from about 0·5 to 3·0 millimetre, depending on the air and moisture-requirements. Smaller crumbs block the air channels without increasing the water-retaining capacity, whilst larger crumbs enhance the rate of evaporation of water, causing plants to die from dessication.

Factors affecting Crumb Formation and Crumb Stability. The proportionate amount of colloidal matter in the soil requisite for the suitable development of a

crumb structure is not known with certainty, although the effects of either too little or too much colloidal matter are well understood. The smaller the colloidal content the larger the pore spaces and the weaker the crumbs. The crumbs dry out more readily, but they yield only small amounts of air when re-wetted. Hence plants are liable to suffer both from water-logging and from drought. The greater the colloid content, the more difficult it is to obtain a good structure. The pores within the crumbs may be too minute to enable plant roots to remove water from them, in spite of the fact that the clay component of the crumbs contains large amounts of water which is tightly held. Hence plants are liable to suffer from lack of water when the clay content is high, even though the total amount of water present in the soil is relatively great.

The effect of organic colloidal matter (humus) so far as is known, is similar in most respects to that of colloidal clay Its main difference probably lies in its effect on crumb size, although the magnitude of this effect has not yet been ascertained. Another important property which organic colloidal matter confers on soil in greater degree than inorganic colloidal clay is to increase the pore space within the crumbs, and thus to improve materially their water-retaining capacity and their ability to supply water at a rapid rate to growing plants. Organic colloid also in some way reduces stickiness and improves a soil's workability, but little is known about the mechanism of these effects. Soils rich in organic matter are never so sticky and are very much more spongy and springy, than soils containing corresponding amounts of colloidal clay. Their humus component probably absorbs more air, and it certainly does not give it up again with the same facility as clay colloid. Highly organic soils are therefore more difficult to wet than heavy clay soils.

The stability of soil crumb is of two sorts, namely mechanical stability and water stability. The former enables the crumb to withstand the action of beating rain or gusty wind; the latter enables it to maintain its structure when thoroughly wetted. Both types of stability appear to depend on the nature, composition and chemical attributes of the colloidal matter that holds the soil particles together. Recent research has established the fact that the seat of the important binding forces is the surface of the colloidal matter. Such surfaces are chemically very active; they are capable of combining with or "absorbing" entities such as water molecules and ions of various sorts, particularly basic ions, for example, calcium, magnesium, potassium, sodium and hydrogen ions. The ability of colloidal material to combine with ions and to exchange them for other ions confers upon it what is known as "base exchange capacity". In order for soil crumbs to be formed, the base exchange capacity of the soil should exceed 20 units (milligram equivalents per 100 grams of soil). The measurement of base exchange capacity is now a routine procedure in soils laboratories so that the soil chemist can readily determine whether or no any given soil is likely to form crumbs easily, merely by determining its total exchangeable base content.

It is quite likely that basic ions bind colloidal surfaces together through bridges of water molecules. The positively-charged (hydrogen) end of the water molecule (H. OH) is attracted to the negatively-charged colloidal surface, and the negatively-charged (OH) end is attracted to the positively-charged basic ion.

The conditions that decide the size of soil crumbs are not yet known, but evidently one factor is the rate of drying. The faster water is removed, the smaller the crumb. Another factor appears to be salt content. Soils having large contents of salts (such as sodium chloride) develop only small crumbs. Such conditions may characteristically occur in nature; for example, arid-land soils are generally subject to rapid drying, and common salt is a usual component in them, so that the natural soil structure in this case is one distinguished by small

crumbs. In soil survey studies observations of the natural size and shape of the crumbs is frequently employed as evidence of the conditions under which soils have been formed.

The proportionate amount of the different exchangeable ions associated with the colloidal matter in a soil seems mainly to decide the water stability of the crumbs. If more than 20 to 30 per cent. of the exchangeable ions of a soil are sodium ions, the soil will usually form crumbs that are markedly unstable when wetted. Such "sodium-clay" soils may produce a good tilth when properly cultivated in favourable weather, but the whole structure rapidly and completely disappears when the first soaking rains arrive. The surface may subsequently solidify into a hard cake after drying conditions have again set in, and plant roots may be injured so that the crop is irreparably damaged. Nevertheless, soils rich in exchangeable sodium-ion, but containing at the same time abundant free sodium salts may appear to possess a stable crumb structure, but this is lost when the excess of salts is washed out or leached away by irrigation with pure water.

On the other hand, soils containing a large proportion of exchangeable calcium-ions usually produce crumbs that are very stable in the presence of water. This fact may partly explain the beneficial effect of thorough liming on the physical properties of acidic clay soils. Much fuller information is needed concerning the water and ionic conditions prevailing in the neighbourhood of colloidal surfaces before the causes of water stability of soil crumb can be fully understood. The different ions operate to different extents, but sometimes in opposite directions. Thus sodium-ion and calcium-ion appear to be antagonistic in their effects on crumb stability, whilst magnesium-ion seems to resemble sodium-ion rather than calcium-ion in their ability to confer a fair degree of crumb stability on a soil containing a sufficient amount of colloidal matter.

In farming practice, mechanical cultivation operates in two chief ways. If the soil possesses a good crumb structure, cultivation improves it by developing tilth which directly benefits the crop by improving the moisture and air conditions. If the soil possesses no crumb structure, and has bad tilth, cultivation puts it into the best condition for weathering agents to act on it. Cultivation implements should be used in such a way that a stable tilth is produced in a previously structureless soil, or an already existing tilth is not destroyed, and at such a time that the greatest benefit to the soil's structure is realised. Successful tillage thus demands knowledge and experience on the part of the cultivator, both with regard to the correct kind of implement to use, and the right time to use it. Thus, a good stable tilth in a heavy clay soil may be completely spoiled by ploughing with a steel mould-board plough when the soil is too wet. Such a soil should either be allowed to dry before ploughing, or a wooden mould-board plough should be employed. Liming has been proved at Rothamsted to reduce the force needed to draw implements through the soil. This effect may be explained by the more stable crumb structure which the lime confers on the soil. Heavy dressings of organic manure produce similar results, whilst cropping with green manures probably aids crumb formation through the binding effects of tiny rootlets.

The formation of a satisfactory explanation of the various stages in crumb production and the elaboration of means of measuring the various factors involved seem now to be within reach. Before long it should be possible to design field experiments to test the main conclusions, and thus further to develop the practice of field husbandry on precise scientific lines.

From *Tropical Agriculture*, Vol. XIII, No. 6, pp. 143 to 145.

Press Service.

Nutrition and Agriculture. Further discussions on the subject of improved nutrition standards, which promised to be highly interesting and important, will take place in October next on the occasion of the XIIIth General Assembly of the International Institute of Agriculture of Rome. Certain special studies of this question have been made recently by the League of Nations and by the International Labour Office, in collaboration with the Institute, which has provided both institutions with an ample statistical documentation. A highly informative report has also been prepared for the Assembly by Mr. McDougall, Delegate of Australia on the Permanent Committee of the Institute. A brief summary of this Report is given in the following paragraphs.

The writer shows in the first place that a satisfactory human dietary must be based on an adequate consumption of the "protective" foods which include milk, cheese, butter and other dairy products, fresh fruit and vegetables, eggs, fish and meat. Unfortunately the special studies and statistics which deal with the subject show that the great masses of the population throughout the world do not consume these particular foods in sufficient quantities. The result is frequently the appearance of "deficiency diseases" such as pellagra and beri-beri, and also, especially in the child population, dental troubles, bone malformation, rickets and a general sub-normal physique.

After having demonstrated the benefits that would accrue to human welfare through the raising of nutrition standards and directing attention to the growing tendency of public opinion to make the State responsible for the supervision of national nutrition, Mr. McDougall considers the effects of such improved standards on agriculture. Consumption of the "protective" foods might go far to cause a revival in the trade in food products If practical steps were taken to bring about a rise in consumption, particularly as regards these particular foods, it would be possible for the industrial countries to concentrate their attention on producing larger quantities of the more perishable foods, and the production of the chief world agricultural staples, such as wheat and sugar, might be left to a greater extent to the great low-cost exporting countries.

Thus the way would be opened for a general recovery in world trade with beneficial effects, not only upon the economic situation, but also on political relations in all countries.

The writer then considers the different methods of improving nutrition, after stating that malnutrition is due in the first place to poverty and in the second to ignorance.

In reference to the first of these factors, he instances certain of the more important suggestions that have been offered. These include the distribution of milk and other food, either free or below cost, to pregnant and nursing mothers, to children below school age and to children at school; the lowering of the margin between wholesale and retail prices where unduly high; differential prices for certain social groups. Further more subsidies, now granted to producers, might in certain cases be utilised as subsidies to consumption.

In regard to the matter of ignorance, the writer considers that the newer methods of popular education, such as broadcasting, the talking film, etc. might be adopted with advantage.

Mr. McDougall lays stress on the value of adequate credit provision, if agriculture is to be called upon to readjust and intensify production. He considers that the idea of an International Agricultural Mortgage Bank, capable of assisting the Governments to turn over to the production of the most economic and

health promoting foods, might now be revived with better hope of success. The great creditor nations would be the more willing to give their support, since they would see that their own economic interests would stand to gain by the operation of the proposed Bank.

Herein, in the view of Mr. McDougall, there may be found a solution of the hotly debated problem of agricultural protectionism. There can be no doubt that the solution of the questions discussed by the writer of this report might contribute in no small degree to a revival in world prosperity.

[*International Institute of Agriculture, Press Service.*]

ABSTRACT

Tobacco in South India. By W. R. C. Paul, M.A , M.Sc., D.I.S., F.L.S. (*Trop. Agri.* LXXXVII p. 3). This crop was first introduced by the Portuguese in the 16th century. Its cultivation was restricted to dark, and strong flavoured types and as such there was no or very little export in the early period. In order to meet the demand of the mild flavoured light tobacco in the United kingdom, efforts were made in the direction of introduction of new types, methods of growing and curing. Madras Presidency occupies second largest position in India with an area of 292,000 acres and outturn of 286,000,000 lb. of cured leaf out of the total area of 1,350,000 acres and production of 1,000 000,000 lb. leaf respectively. The different kinds of tobacco grown may be grouped under (a) smoking (b) chewing (c) snuff. Dark tobaccos are strong flavoured and are used in the manufacture of cigars, cheroots, chewing and snuffing. Light tobaccos are generally associated with mild flavour and comprise cigarettes, pipe mixtures and beedies. The light tobacco industry has developed during recent years due largely to the efforts of the Indian Leaf Tobacco company, and Guntur District forms the chief centre of its cultivation with about 40,000 acres under the virginian variety Harrison's special. The flue-cured Virginia is used for manufacturing standard brand cigarette while the sun-cured stuff and the finer country types are mostly used in blending the innumerable other cheaper brands and pipe tobaccos, and are exported to United Kingdom and Japan.

Cigar filler tobacco is mostly drawn from certain areas in Dindigul and Trichinopoly while cheroot tobacco is extensively cultivated in the Districts of Madura Coimbatore, Trichy, Salem, Kistna, Godavari and Vizagapatam to the extent of 105,000 acres. Soil and weather conditions determine the quality of the tobacco. Light soils are suited for mild bright tobaccos, and heavy soils for coarse dark types. Application of cattle manure produces excess of chlorides in the leaf and the burning quality is poor On the other hand application of organic manures leads to a high nicotine content. Irrigation is found better for chewing and cheroot types, and brackish water produces a greater potash content.

Tobacco curing may be either by flue, sun or air Most of the light virginians are flue-cured and usually contain about 13% moisture at the time of export.

There are about 30,000 barns in the Guntur area. R. B.

Gleanings.

Vitamins and Plants. In general, vitamins are products of the vegetable kingdom. Their possible role in plants, however, has been almost totally unknown until quite recently.

Some years ago we followed the synthesis of carotene (the precursor of vitamin A) and vitamin C (ascorbic acid) in plants, and observed that the percentage content of these compounds in the plant is generally the higher the better

the plant grows. Their concentration thus reaches a maximum at an early stage of growth, either before or at the beginning of flowering. Similarly we found that an adequate fertilisation increases the percentage content of vitamin C and carotene. The view that artificial fertilisers would seriously affect the composition of plants is thus not tenable, at least where vitamins are concerned. This fact was clearly demonstrated by Scheunert's prolonged work on rats.

On the other hand, we found that all factors which have an unfavourable influence on the growth of plants, such as soil acidity, excessive concentrations of phosphate, potassium, sodium chloride, etc., lower the content of carotene and vitamin C in plants. In my opinion, these facts showed, although indirectly, that carotene and vitamin C are important growth factors of plants.

In the case of vitamin C, this assumption has now been conclusively proved by further work in this laboratory (S. V. Hausen.) Addition of crystalline vitamin C to the medium in sterile pea cultures led to an increase of 40—100 percent in the dry weight of the treated plants. (At the same time it was noted that the roots of the plant protect vitamin C very effectively against autoxidation). The effect of vitamin C on growth is a specific one, since, for example, glucose has *no* such effect. It was also shown that the peas actually took up with their roots vitamin C from the medium. Shortly after, L Havas at Rothamsted made similar observations.

These results showed that an addition of vitamin C to the medium promotes markedly the growth of the plant, but they did not conclusively prove that vitamin C is essential for plants. Definite proof for the latter fact has, however, now been obtained through Miss. V. Hausen's work on pea seedlings which were deprived of their cotyledons at a suitable stage, when they contained about ninety per cent of the total vitamin C present in the seedling. Such seedlings generally die or remain completely dwarfed, whereas they will develop distinctly better, and even produce normal blossoms, when small amounts of pure ascorbic acid are added to the medium. Even the treated plants naturally suffer from the removal of cotyledons, which evidently contain also other necessary compounds besides vitamin C. The accompanying table will illustrate the effect of ascorbic acid on the development of cotyledon-less seedlings.

'Torstal' peas (cotyledons removed) in sterile Hiltner's solution with ($Ca(NO_3)_2$; initial pH 5·5 Time of growth 29 days.

	Average length of two plants in cms.		Dry weight of two plants, in grams.		Vitamin C in two plants, total (ml. of ind. solution).	
	Treated.	Controls.	Treated.	Controls.	Treated.	Controls.
	83	35	0·431	0·070	22·8	2·7
	66	30	0·305	0·063	12·5	2·0
	75	30	0·461	0 075	22·5	2·8
	82	22	0·405	0·044	17·5	1·5
Normal plants (cotyledons not	—	85	—	1·850	—	4·80
removed; ascorbic acid not added)	—	92	—	1·706	—	44·0

It is therefore reasonable to regard vitamin C as a phytohormone, which is indispensable to plants. The formation of vitamin C during germination is necessary for the early development of the plant. During later stages of growth, large quantities of vitamin C are produced in connexion with photosynthesis,

So far, vitamin C is the only vitamin the indispensability of which to higher plants has been proved through *direct* experiments. Corresponding work on vitamin B_2 (lactoflavine) is at present in progress in this laboratory.

W. H. Schopfer has recently shown that vitamin B_1 promotes greatly the growth of lower fungi (Phycomyces, etc.). According to his results, the effect is very delicate and specific, so that it can be used for the quantitative determination of B_1.

The fact that certain compounds, which act as vitamins in the animal organism, have important functions in plants, is additional evidence of the similarity of the metabolism of plant and animal cells.

—*Artturi I. Virtanen.*

Review.

Hoard's Dairyman. This Journal contains a lot of useful information for persons connected with dairying and the care of animals. Some of the articles published by successful dairymen and business people are exceptionally good and are good examples to follow. Lists of important bulletins are also published. Pages are also allocated for articles on Poultry breeding and Veterinary matters which contain a lot of useful tips. Even the farmer's wife is not forgotten; recipes and notes on the home are also included. The cost of the Journal is small due to the large number of subscribers.

R. W. L.

Agricultural Jottings.

Campaign against Chillies Thrips. Chillies occupy an area of about 43,000 acres in the sixth circle comprised of Madura, Ramnad and Tinnevelly districts. Till very recently this crop gave satisfactory returns, yielding about 6 pothies of 250 lbs. each of dry chillies per acre. Of late the yield has been reduced considerably due to some cause or other. One of the causes, if not the chief cause, of this reduction in yield is the severe infestation of 'thrips'. Thrips are small straw coloured active insects which attack the plant in all stages of its growth. They suck up the 'sap' from the tender growing portions of the plant which make the leaves to shrivel up irregularly, causing leaf curl disease. The plants get stunted bear only a few flowers and of these only a small number grow up to the fruiting stage. In worst cases the plants dry up completely and do not flower at all and the farmer is forced either to give up the infested crop or to recultivate it, if the season is favourable, with fresh healthy seedlings.

It has been observed that during normal seasons the plant may be kept free from leaf curl disease by giving better preparatory cultivation, heavy manuring, frequent irrigation and above all by getting healthy and vigorous seedlings for planting. As the normal favourable season cannot be expected always, the cultivators are advised to take some precautionary measures to protect their crop by adopting suitable prophylactic measures against the attack of thrips. Remedies to mitigate the disease or to prevent it entirely are very simple and effective. Healthy seedlings may be obtained by treating the seedlings in the nursery with tobacco dust once a week or so from about 10 days after germination and rinsing them in tobacco decoction before planting.

During adverse season, in spite of the above precautions thrips get the upper hand even though healthy seedlings are planted. In such circumstances the

plants may be protected from the infestation of thrips by timely sprayings with tobacco decoction.

An acre of treated crop gave an increased yield of 22·65% over the untreated plot under similar conditions. The best of our demonstration plot at Uthamapalayam gave an acre yield of 10 pothies per acre, while the maximum yield of untreated fields was only 6 pothies. It costs only Rs. 10 per acre to treat the seedlings and to spray the crop thrice against thrips infestation which is about one-tenth of the cost of cultivation.

As chillies are being cultivated widely and in almost all seasons, the leaf curl disease can be controlled only with the active co-operation of the ryots of the area. Indifference on the part of a few will spoil the neighbours' crop as well to some extent, in spite of the precautions taken by the latter to protect their crops. If only the ryots take to better manuring, cultivate properly and spray in time according to season, a better harvest may be ensured.

The Cambodia Cotton Seed Multiplication and Distribution Scheme. Cambodia cotton (Gossypium hirsutum), a type of American cotton was introduced into South India in 1905 from the province of Cambodia in Indo-China. The yield and quality of the cotton soon attracted attention and the acreage both irrigated and unirrigated increased rapidly mainly in Madura and Coimbatore districts. Owing to the fact that other cottons were being grown side by side e. g., Karunganni, Uppam and Nadam, mixing of kappas before ginning was rife and soon mixed seed was being sown by the ryots to the detriment of quality and outturn.

In order to cope with this problem, the Department of Agriculture started selection work in Cambodia and strain No. 15 was released in 1921—22. In 1924—25, this was replaced by Co. 1 and in 1928—29 by Co. 2. The seed released by the Cotton Specialist, was taken over by the district staff and grown pure by ryots on seed farms under the supervision of the Agricultural Department. The kappas so produced was collected and ginned and the seed thus obtained was carefully stored for distribution during the next sowing season.

When Cambodia seed farms were first started, the Department issued free seed, rogued the crops, advanced cultivation expenses to Rs. 30 per acre and then purchased the kappas from the ryots. With the development of Co-operative societies, advances to ryots were given by the Co-operative societies and purchase of kappas was stopped. Instead there was introduced the system of co-operative ginning, departmental officers acting as advisers in regard to ginning and sale of lint. All good seed was purchased by the department after ginning, at a premium of about Rs. 6 to Rs. 8 per 1000 lbs. About 1000 acres of seed farms were thus being handled by the Deputy Director of Agriculture, VIII Circle, Coimbatore with 12 limited liability Co-operative societies formed for the purpose in Avanashi and Tirupur areas.

The amount of seed produced on 1000 acres of seed farms was at most only sufficient to sow about 8000—10,000 acres of Cambodia out of a total acreage of over 1 lakh acres of Cambodia cotton. Full advantage could not be taken of this specially produced seed as mixing of the kappas with poorer types of Cambodia and other varieties of cotton led to mixed seed in the following year and the purity of the good seed was not maintained.

It therefore became necessary to produce good Cambodia seed on such a scale that almost the total acreage under this variety could be sown with pedigree seed. Such a scheme was drawn up in 1931 to be run by the Tirupur Co-operative Trading Society, Tirupur under advice from the Agricultural Department and financed by the Indian Central Cotton Committee. The scheme was put into operation in 1932 and the staff, acreage and seed production estimated as follows:

Year.	*Agricultural staff paid from Indian Central Cotton Committee funds.*	*Actual seed farm acreage* (Acres).	*Production of seed in maunds.*	*Sufficient to sow.** Acres * (approximate).
1932—33.	Business Manager and 2 Agricultural Demonstrators.	1739	19,944	20,000
1933—34.	—do.—and 4 —do —	4122	29,596	30,000
1934—35	—do.—and 6 —do.—	5152½	53,545	54,000
1935—36.	—do.—and 6 —do.—	5320	45,995	46,000

The Business Manager and his staff are responsible for arranging the seed farms with the ryots, who should belong to a co-operative society, so that they may be financed if necessary through them. Advice is given during the cultivation period and kappas are collected in a central ginning factory usually in Tirupur for ginning. Ginning is carried out under the supervision of the Business Manager and the Agricultural Demonstrators and help is given to the ryots in the disposal of lint.

After ginning, all seeds of good germination capacity are purchased outright from the ryots by the Tirupur Co-operative Trading Society at a premium. The seed is carefully stored and during the next sowing season is issued for sale by the Tirupur Co-operative Trading Society, any profit on the transaction going to the society. In order to prevent any serious financial loss to the Tirupur Co-operative Trading Society, the Indian Central Cotton Committee has guaranteed interest on the money spent on the purchase of seed during the period between the purchase and sale of the seed, and also any loss incurred up to 10% of the total value of seed purchased.

Seed from the Cotton Breeding Station and Central Farm is handed over to the Deputy Director of Agriculture, Coimbatore, who grows it on the Departmental seed farms (inner area). Seed from this inner area is given to the Seed Multiplication Scheme for their 6000 acres seed farms (outer area) and from this area the pedigree seed is sold direct by the Tirupur Co-operative Trading Society to the ryots growing the commercial crop on up to 100,000 acres. The scheme is therefore a direct link in the chain from the Cotton Specialist to the ryot growing the commercial crop and pure seed is produced on such a large scale that few ryots who want good seed need go without it.

Correspondence.

I

To The Editor, Madras Agricultural Journal.

Sir,

Please publish the following in your valuable journal.

In an Industrial taluk like Coimbatore cereals are being sold at the same price as those prevailing in places with no iudustries and no scarcity of labour. But the agricultural wages are higher than elsewhere. Such a condition hits the landed interest rather hardly.

There is a competition between the mills and the ryots with regard to finding out the required labour with the result that the labour charges increase often, the increase in some months being double or treble of what is going on in non-industrial places. The little margin of profit is thus deprived of and the cultivator suffers much from being in the proximity of the mills and other industrial concerns.

Further the ryot's cotton-lint is knocked off at 5 annas a pound and resold to him as cloth at 32 annas a pound. The higher wages paid in the mills are made good by the differences between the low price paid for lint and high cost of the cloth sold to the ryot himself. Thus the Coimbatore ryot loses both ways.

Avarampalayam. }
10—9—1935. }

A. P. Krishnaswamy Naidu,
Landlord.

II

Dear Sir,

I have got about 110 acres of dry land in the villages of Nandyal, Polur, Munagole and Rayamalpur all within a radius of 1½ miles from Nandyal town. I am now getting a rent of Rs. 500 and the lands are estimated to cost Rs 15,000. I have also a house in the village and I can place it at the disposal of the man who takes up cultivation. I am prepared to lease out the lands on the same rent. I can also finance him to the extent of Rs. 1000 towards the purchase of two pairs of bulls and the necessary agricultural implements provided he furnishes necessary security. I shall agree to any conditions that you propose regarding the discharge of the amount mentioned and the further profits that may accrue. I shall be glad if you can secure an agricultural graduate to take up this cultivation. I can lease out the lands to any period extending up to 20 years. I enclose herewith the list of lands showing the Survey Nos. and their extent.

Yours sincerely,
G. Subba Reddy,
Deputy Collector, Cuddapah.

List of lands showing the Survey Nos. and their extent of M. R. Ry. Rao Bahadur C. Subba Reddi Garu, Deputy Collector, "Ramaprasad", Cuddapah. Rayamalpuram: Survey Nos. 111 (7·49); 155/4 (0·08); 29 (0·58); 60 (1·33); 21 (9·74); 23 (6·15); 103 (1·05); 129 (1·03); 73 (12·22); 15 (6·66); 16 (3·55); 17 (3·04); 116 (3·54); 189 (2·11); 178 (7·62); 190 (3 91); 130 (6·82); 102 (1·20); 142/1 (0 09); 146 (0·10); 138 (0·32); 171 (1·00); 183 (0·75); 25 (0·11); 72/1 (11·72); 154 (0·37); 198 (0·84). Nandyal 59 (7·45); 60 (3·00); Polur 196 (7·14); Munagole 56 (2·04).

III

NANDY SAYS

Listen! What Nandy says
The part in Country's wealth he plays
" Why not fence and fodder grow
To feed us man? Tell us so.
No use to graze the barren waste
With numbers large and wakeful taste.
Grounds we lost by slow Darkast
And that now men learn to their cost.
How weak we are with scanty food!
To hope to fill the barn no good.
To plough the field and grow more corn
As farmers' servants are we born
In places all with milk of bold
Our sisters nurse the young and old

Feed us well. Fast no more
A willing hand will give you more.
We and you a happy band
Will soon make this a fertile land ."

K. R. SANKAR,
An Old Student of the College.

Crop & Trade Reports.

Receipts of raw cotton at presses and Spinning Mills.

Total cotton pressed and unpressed..

	Bales of 400 lbs. against an estimate of 540,700 bales for 1935-36.	Figures for corresponding period in previous year.
1—2—36 to 21—8—36	481,046	368,051
„ 28—8—36	494,443	376,746
„ 4—9—36	504,034	383,258
„ 11—9—36	511,654	387,447
„ 18—9—36	523,524	395,283
„ 25—9—36	530,582	399,710
„ 2—10—36	541,798	402,802
„ 9—10—36	548,884	406,313

	Cotton bales received at Mills.	Export by Sea.	Import by Sea.
1—2—36 to 21—8—36	288.936	164,063	90,720
„ 28—8—36	295,097	179,490	90,928
„ 4—9—36	300,281	189,062	91,567
„ 11—9—36	305,138	195,959	92,948
„ 18—9—36	310,144	198,603	92,949
„ 25—9—36	317,056	203,776	93,221
„ 2—10—36	324,424	206,314	93,295
„ 9—10—36	328,797	218,521	93,819

Sugarcane—Second report. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1934-35 has represented 3·6 per cent of the total area under sugarcane in India.

2. The area planted with sugarcane up to the 25th September 1936 is estimated at 109,690 acres. When compared with the area of 114,090 acres estimated for the corresponding period of last year, it reveals a decrease of 3·9 per cent.

3. The decrease in area occurs outside East Godavari, West Godavari, Guntur, the Deccan, Nellore, Chingleput, Chittoor, North Arcot, Tanjore and the West Coast.

4. The condition of the crop is generally satisfactory except in Chittoor and North Arcot where the crop has been affected by drought to some extent. If a normal season is experienced during the rest of the growing period, the yield is estimated at 308,820 tons of jaggery as against 328,780 tons for the corresponding period of last year.

5. The wholesale price of jaggery per imperial maund of 82-2/7 lb. towards the close of September 1936 was Rs. 6—1—0 in Adoni, Rs. 6 in Madura, Rs. 5—9—0

in Nandyal, Rs. 4—15—0 in Bezwada Rs. 4—12—0 in Guntur and Tuticorin, Rs. 4—10—0 in Masulipatam and Kumbakonam, Rs. 4—5—0 in Rajahmundry and Ellore, Rs. 4—2—0 in Bellary, Rs. 4—1—0 in Coimbatore, Rs. 3—12—0 in Cocanada, Rs. 3—11—0 in Cuddapah and Salem, Rs. 3—10—0 in Vellore, Rs. 2—14—0 in Vizagapatam, Rs. 2—10—0 in Trichinopoly and Rs. 2—8—0 in Tinnevelly. As compared with the prices of the previous month, the prices reveal a fall of 8 per cent in Adoni, 7 per cent in Tuticorin, 6 per cent in Cuddapah, Salem and Kumbakonam, 5 per cent in Cocanada and Tinnevelly, 4 per cent in Vizagapatam and one per cent in Ellore. The prices remained steady at other centres.

Paddy—First Forecast Report. The average of the areas under paddy in the Madras Presidency during the five years ending 1934-35 has represented 13·4 per cent of the total area under paddy in India.

2. The area sown with paddy up to the 25th September 1936 is estimated at 6,010,000 acres. When compared with the area of 5,827,000 acres estimated for the corresponding period of last year, it reveals an increase of 3·1 per cent.

3. The increase in area occurs in all the districts outside East Godavari, Kistna, Anantapur, Cuddapah, Nellore, South Arcot, Chittoor, North Arcot, Salem, Coimbatore, South Kanara, and the Nilgiris. There is a marked decrease in area in Nellore owing to the unfavourable season.

4. The first crop of paddy is being harvested in parts of Trichinopoly, the South, and on the West Coast. The yield is expected to be about normal. The condition of the standing crop is generally satisfactory except in Nellore.

5. The wholesale price of paddy per imperial maund of 82-2/7 lb. as reported from important markets towards the close of September 1936 was about Rs. 3—0—0 in Cuddapb, Rs. 2—14—0 in Vizianagaram, Rs. 2—11—0 in Nellore and Salem, Rs. 2—8—0 in Erode and Madura, Rs. 2—6—0 in Vellore, Rs. 2—5—0 in Nandyal, Rs 1—14—0 in Nagapatam, Rs. 1—13—0 in Kumbakonam, and ranged from Rs. 2 to Rs 2—4—0 in the other markets. As compared with the prices reported in January 1936, these prices are stationary in Cocanada and Masulipatam, while they reveal a fall of 15 per cent in Tinnevelly, 10 per cent in Nandyal, 9 per cent Erode, and one to four per cent in Rajahmundry, Bezwada, Nellore, and Nagapatam, and a rise of 20 per cent in Salem, 15 per cent in Cuddapah, 10 per cent in Guntur, 9 per cent in Viziangaram, 7 per cent in Madura, and 2 to 5 per cent in the other markets.

Cotton—Second Forecast Report. 1936-37. The average of the areas under cotton in the Madras Presidency during the five years ending 1934-35 has represented 9 per cent of the total area under cotton in India

2. The area under cotton up to the 25th September 1936 is estimated at 756,700 acres. When compared with the area of 1,148,600 acres estimated for the corresponding period of last year, it reveals a decrease of 34 per cent. The decrease in area occurs in almost all the important cotton growing districts and is marked in the Deccan where the area fell from 811,500 acres to 448,500 acres, i. e., by about 45 per cent owing to want of timely and sufficient rains.

3. The area in the South and the Central districts relates partly to the last year's crop and partly to the current year's sowings which have commenced in parts.

4. The condition of the standing crop is satisfactory except in the Deccan where it has been affected by drought to some extent.

5. The wholesale price of cotton lint per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of September 1936 was about Rs. 19—7—0 for Cocanadas. Rs. 23—11—0 for Red Northerns, Rs. 18—11—0 for

Westerns, Rs. 25—4—0 for Cambodia, Rs. 24—5—0 for Coimbatore Karunganni, Rs. 23—2—0 for Tinnevelly Karunganni, Rs. 22—8—0 for Tinnevellies, and Rs. 21—4—0 for Nadam cotton.

As compared with the prices in the previous month, the prices of Cocanadas, Cambodia, Karunganni, Tinnevellies and Nadam cotton have remained stationary while those of Northerns and Westerns cotton show a fall of eight and two per cent respectively.

Gingelly—Second Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1934-35 has represented 11·6 per cent of the total area under gingelly in India.

2. The area sown with gingelly up to the 25th September 1936 is estimated at 437,200 acres. When compared with the area of 388,300 acres estimated for the corresponding period of last year, it reveals an increase of about 12·6 per cent.

3. The increase in area is general, outside West Godavari, Kistna, Kurnool, Nellore, Salem, Trichinopoly, the South and South Kanara. The increase is marked in Vizagapatam (+30,000 acres) and Chingleput (+12,300 acres).

4. The early crop of gingelly has been harvested in parts. The yield was generally normal. The condition of the standing crop is fairly satisfactory except in parts of Bellary and Anantapur where it has been affected by drought to some extent.

Groundnut—Third Report—1936. The average of the areas under groundnut in the Madras Presidency during the five years ending 1934-35 has represented 45·4 per cent of the total area under groundnut in India.

2. The area sown with groundnut up to the 25th September 1936 is estimated at 2,853,100 acres. When compared with the area of 1,978,000 acres estimated for the corresponding period of the previous year, it reveals an increase of 44·2 per cent.

3. The increase in area is general outside Trichinopoly, Ramnad and Tinnevelly. The increase is marked in Kistna, Guntur, the Deccan, South Arcot, and North Arcot.

4. The summer crop throughout has been harvested. The yields were generally normal. The yield of the early crop in Salem and Coimbatore is reported to be normal.

5. The condition of the main crop is reported to be generally satisfactory outside the Deccan, Nellore and South Arcot where the crop has been affected by drought to some extent. In parts of South Arcot the crop has been attacked by the hairy caterpillar.

6. The wholesale price of groundnut (shelled) per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of September 1936 was Rs. 6—6—0 in Vizianagaram, Rs. 6—3—0 in Guntur, Rs. 6—0—0 in Cocanada and Cuddalore, Rs. 5—14—0 in Vizagapatam, Rs. 5—12—0 in Nandyal, Rs. 5—11—0 in Vellore, Rs. 5—9—0 in Negapatam, Rs. 5—5—0 in Madura, Rs. 5—2—0 in Cuddapah, Rs. 4—15—0 in Adoni, Rs. 4—12—0 in Salem, Rs. 4—7—0 in Ellore and Rs. 4—3—0 in Tinnevelly. When compared with the prices reported towards the close of July 1936, these prices reveal a rise of 24 per cent. in Tinnevelly, 21 per cent. in Madura, 6 per cent in Ellore and Nandyal, and 5 per cent. in Vizianagaram, Cocanada and Guntur, and a fall of 16 per cent. in Salem, 15 per cent. in Cuddalore, 12 per cent. in Cuddapah, 11 per cent. in Negapatam, 10 per cent. in Adoni, 6 per cent. in Vizagapatam, and 5 per cent. in Vellore.

College News and Notes.

Students' Corner. *Hockey Tour to Ceylon.* Thanks to the untiring efforts of Mr. H. Shiva Rao, the Vice-President of our club, the long contemplated and eagerly longed for tour to Ceylon at last materialised and we left Coimbatore on Friday the 18th September. The team was represented by Messrs. S. V. Joseph Das (Captain) K. K R. Menon, P. M. Somanna, M. Mukundan, V. Brahmanandam, Ayappa, Herbert, T. P. S Nainar, B. K. Mohanrao, D. V. Rajagopal, Kesava Reddi, K. Santhanam and S. Sundararaman. We arrived at the Colombo Fort station on the 20th morning, where the University College authorities mustered strong to accord us a warm and cordial welcome. The tour being only of a week's duration, we had to keep an engagement on the very day of our reaching the destination.

The first match of the tour was played against the Tamil Union Hockey Club. Being tired after the tedious journey and also being quite unaccustomed to play on lawns we could not put forth our best that day. The game was eventless throughout, but towards the end of the second half the Tamil Union forced a corner and converted it into the only goal of the evening.

Not dispirited by the initial reverse we played against the Varsity XI and Varsity past and present combined XI on the 21st and 22nd September, respectively. We were able to give a better account of ourselves on both the occasions by winning these encounters without much effort, the scores being 3 : nil and 5 : 1 respectively.

A visit to Kandy and Perndeniya gardens was included in the tour to provide a short respite and also to combine a little sight seeing and horticultural instruction. The trip undertaken on the 23rd morning was very beneficial from the point of view of horticultural knowledge and the authorities of the world famous gardens spared no pains to take us round and explain the aims and activities in progress. On the evening of our arrival there we had the honour of being the guests of Mr A. Vittal Pai, I.C.S. the agent to the Government of India. We had a sumptuous tea with him and Mrs. Pai, followed later by a very appetising South Indian dinner which we very much enjoyed.

We returned to Colombo on the same night and resumed the rest of our engagements by taking on the Ceylon Hockey Association on the 25th evening. In spite of inclement weather and sodden ground we were able to exhibit a high standard of game and claim a victory over the best combination in Ceylon by 3:1.

The last match was played on the 26th evening against the Colombo Y.M.C.A. Our attack was completely off colour that day so much so, our defence had to do double work of initiating attacks as well as keeping at bay the opposing forwards. Nevertheless we were able to lower the colours of our opponents by claiming a win by 2 goals to nil

After this very enjoyable stay and a sequence of success after the initial defeat, we left Colombo on the 26th evening amid cheers and arrived at Coimbatore on the 28th evening, after a day's halt at Rameswaram.

We the members of the Agricultural College hockey team take this opportunity to express our indebtedness and sincere gratitude to the Principal and Hockey Captain of the University College, Colombo, for having entertained us and made our stay at Colombo enviably enjoyable, also to Mr. and Mrs. A. Vittal Pai for the keen interest they evinced in our tour. Our thanks are also due to Mr. E. J. Verghese, the officer in-charge, for having made the tour a grand success.

S. V. J.

Football. The first match of The Abraham Memorial Foot-ball Tournament which ended in a draw was played against the Sarvajana High School, in the Stadium grounds on Friday the 9th October. The same match replayed on the 12th instant, resulted in a victory for us by one goal to nil. The full backs of the opponents kept an effective check on our forwards. On the whole our players played a good game on both the days and our 'goalie' was responsible for warding off many balls.

The next match of the tournament has to be played against the Municipal High School.

A combined eleven of both the students of the Agricultural College and officers played a match against the Mysore Medical College in our grounds on the 13th inst. The visitors were defeated by three goals to one.

Tennis. Our College represented by Messrs. K. K. R. Menon and Narayana Rao was defeated by the Medical College, Mysore, by 6 : 1.

Volley Ball. A match was played against the Mysore Medical College on the 14th instant. Here again the visitors scored over us. But our full team was not represented owing to the 3rd year students being away on tour. The third year students were on an agricultural tour to Ongole, Hagari, Bangalore, Hebbal Farm and other places. They returned only on the 16th morning.

Visitors. Dr. Ekambaram, Professor of Botany, Presidency College, Madras who accompanied the students of the final year Honours Course on a tour, stayed here on the 29th and 30th visiting the various breeding sections.

Weather Review (SEPTEMBER 1936).

While the monsoon in the Peninsula was generally weak on most of the days the bay monsoon was strong and active during the first two weeks of the month. The monsoon weakened during the third week and withdrew from the country by the 18th.

The activity of the monsoon was associated with the movement of two depressions. The first of these appeared over the Central Provinces on the 31st of August and moving northwards, weakened and filled up two days later. The second depression formed in the North Bay of Bengal on the 6th of September, passed inland across the Orissa coast and by over the East Central Provinces on 7th and 8th. It then moved slightly North west and got merged into the seasonal low over North west India near Neemuch on the 10th. Wide spread and locally heavy rain fell along and near the tracks of these depressions.

During the latter half of the month, associated with thunderstorms there was general rain in the Peninsula and other parts of the country.

Conditions became markedly unsettled from the North Andaman sea to the East Central Bay of Bengal and a deep depression of small extent formed off Irrawaddy on the 29th. This depression filled up on the 30th, but a trough of low pressure continued to extend from the Arakan to the Orissa Ganjam coast and conditions were markedly unsettled in the Central and North Bay of Bengal.

Rainfall was in defect in North Madras coast and Ceded districts, almost normal in South Madras and in excess in parts of West Coast, Mysore, Coorg, and the Hills.

Mean maximum temperatures were generally above normal in the Peninsula during the first three weeks. Nellore recording the highest maximum temperature of 103°F. The skies were moderately to heavily clouded.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st	Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	5·4	-2·1	66·0	South	Negapatam	0·7	-3·1	17·0
	Berhampore*	8·6	+0·1	50·4		Aduthurai*	2·7	-0·1	17·4
	Calingapatam	2·4	-5·0	35·5		Madura	4·5	-0·6	18·3
	Vizagapatam	2 6	-3·9	23·5		Pamban	1·8	+0·6	7·7
	Anakapalli*	1·9	-5·6	28·9		Koilpatti*	2·3	+0·3	11·3
	Samalkota*	0 0	0·0	00·0		Palamkottah	2·7	+1·4	14·9
	Maruteru*	6·5	-0·1	40·4					
	Cocanada	8·3	+2·5	40 9					
	Masulipatam	3·6	-2·6	35 2	West Coast	Trivandrum	9·1	+5·0	53·5
	Guntur*	1·3	-5·4	30·2		Cochin	16·6	+7·6	101 9
Ceded Dists.	Kurnool	2·2	-4·0	14·5		Calicut	11·4	+3·7	123·5
	Nandyal	2·1	-3·9	19·4		Pattambi*	16·2	+7·7	100 9
	Hagari*	7·5	+1·9	15·1		Taliparamba*	8·5	-1·8	116·9
	Bellary	5·0	-0·1	12·4		Kasargode*	5·3	-4·0	140·6
	Anantapur	6·6	-0·7	13·0		Nileshwar*	5·7	-3·8	128·3
	Rentachintala	2 4	—	17·5		Mangalore	17·8	+7·4	149·6
	Cuddapah	3·5	-2·8	12·9					
	Anantharajupet*	6·4	—	—	Mysore and Coorg	Chitaldrug	6·1	+1·5	13·6
Carnatic	Nellore	3·5	-1·3	12·3		Bangalore	7·5	+0·4	25·8
	Madras	1·9	-3·1	19·6		Mysore	9·5	+4·6	32·0
	Palur*	4·4	+1·2	21·6		Mercara	12·7	+1·9	145·1
	Tindivanam*	2·1	-1·6	16·8					
	Cuddalore	5·7	-0·4	17·7	Hills.	Kodaikanal	13·8	+6·5	43·0
Central	Vellore	7·7	+0·4	18·0		Coonoor*	6·0	—	43·7
	Salem	6·6	0·0	33·0		Ootacamund*	7 5	+3·1	42.4
	Coimbatore	1 9	+0·4	13·3		Nanjanad*	8 5	+3·7	44 9
	Coimbatore Res. Inst.*	0 9	-1·5	12·1					
	Trichinopoly	3·3	-1·5	15·6					

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Weather Report for the Research Institute Observatory.

Report No. 9/36.

Absolute Maximum in shade	...	93 3°F.
Absolute Minimum in shade	...	66·8°F.
Mean Maximum in shade	...	89 9°F.
Departure from normal	...	+0·9°F.
Mean Minimum in shade	...	71 2°F.
Departure from normal	...	+0·6°F.
Total rainfall	...	0 94"
Departure from normal	...	-1·5"
Heaviest fall in 24 hours	...	0·26"
Total number of rainy days	...	3 days.
Mean daily wind velocity	...	2·7 M. P. H.
Mean Humidity at 8 Hours	...	75·5%
Departure from normal	...	+0·5%

Summary. Rainfall was in large defect. Dry weather prevailed during the first two weeks of the month. The maximum and minimum temperatures and the humidity were slightly in excess of the normal.

Departmental Notifications.

Appointments and Promotions. Mr. G. C. Balanna, F. M. under training at A. R. S. Nandyal is appointed to officiate as assistant in Millets vice Mr. N. Krishnaswami on leave The following provisionally substantive promotions of Upper subordinates in the Agricultural section are ordered, from V grade to IV grade. Mr. M. Narayana Iyer, A. D. III circle from 8th August 1935. Mr. T. V. Krishnaswami Rao, A. D. Sompeta from 8th August 1935. Mr. A. Ramalinga Iyer, A. D. Trichendur from 29th October 1935. Mr. K. Ramaswami Iyer, Upper subordinate IV grade (provisionally substantive) to be substantive in IV grade with effect from 8th August 1935. Mr. M. K. Swaminatha Iyer, IV grade (provisionally substantive) to be substantive in IV grade with effect from 8th August 1935. Mr. A. Krishnaswami Iyer, Upper subordinate IV grade (provisionally substantive) to be substantive in IV grade with effect from 29th October 1935. Mr. M. A. Sankara Iyer, Assistant, Millets section is promoted to IV grade with effect from 22nd May 36.

Transfers. Mr. P. Sitharamayya. A. D. under training, Kovvur to A. R. S. Maruteru to officiate as F. M. The transfer of Mr. H. Narihari Rao, Poultry Assistant from Anakapalle to Guntur already ordered will be held in abeyance till further orders. Mr L. Narasimhacharya. F. M., A. R. S. Guntur to IV circle and is posted as A. D Ponneri, Chingleput District. Mr. P. Kannappa Pillai, A. F. M., A. R. S. Koilpatti to VII circle and is posted to A. R. S. Taliparamba. Mr. S. Subbiah Pillai, Assistant in Paddy, A. R. S. Aduturai to Tinnevelly to report himself for duty to A. D. A. Tinnevelly. Mr. V. Srinivasan, F. M. under training, A. R. S , Aduturai to officiate as Assistant in Paddy in the same station. Mr. S. Ramachandra Rao, Assistant in Paddy Section, Coimbatore to Nellore to report himself for duty to the A. D. A. Nellore. Mr. C. Doraiswami, officiating Assistant in Paddy, A. R. S. Maruteru to Coimbatore. Mr. N. H. V. Krishnamurthi, officiating F. M A. R. S. Maruteru to officiate as Assistant in Paddy in the same station Mr. K. Rangaswami Iyangar, Assistant in Botany, A. R. S. Anakapalle to Maruteru to officiate as Farm Manager. Mr. P. Kesavanunni Nambiar, F. M., A. R S. Pattambi to VIII Circle. Mr. L. Krishna Iyangar, A. D. Co. 2. Scheme to V circle to report himself for duty to the Dy. Director of Agriculture, V Circle, Trichinopoly. Mr. V. K. Kunhunni Nambiar, F. M., A. R. S., Erayenur to A. R. S. Pattambi. Mr. C. S. Sankaranarayana Iyer, F. M., A. R. S., Pattambi to the Potato Research Station, Nanjanad. Mr. K. Govinda Kurup, Probationer under training at the Research Station Nanjanad to A. R. S. Pattambi. Consequent on the transfer of Mr. L. Narasimha Acharya, F. M., A. R. S , Guntur to IV Circle, the following arrangements are ordered. Mr. S. Sithapathi Rao, A. D., Kovvur will be in additional charge of Nellore Sub Circle. Mr. K. V. Gaurangamurthi, A. D., Nellore on relief by Mr. Sithapathi Rao will relieve Mr. A. Venkatarangam, A. D. Atmakur. Mr. A. Venkatarangam on relief by Mr. K. V. Gaurangamurthi will immediately relieve Mr. L. Narasimhachari. Mr. M. Narayana Iyer, A. D , Kurnool Division on the expiry of his leave on 3—10—36 after-noon, is posted to Jammalamadugu for District work in the Cuddappah district to open a new sub-circle. Mr. M. Jivana Rao. A. D., Nandyal to Sirugupa Sub-Circle as A. D. Mr A. Ramaswami Iyer to be A. D., Polur. Mr. T. K. Mukundan from Polur to be A. D., Vellore. Mr. M. K Swaminathan from Vellore to be A. D., Arkonam. Mr. N. V. Kalyanasundaram from Tirukoilur to be A. D. Chengam. Mr. B. G. Narayana Menon, Offg , A. D., Gobichettipalayam to Pollachi, Sub-Circle. Mr. N. Srinivasa Rao, A. D. Pollachi to Tirupur Sub-Circle Mr. T. K. Thangavelu, A. D., Gobi is posted for van duty from 1—10—36. Mr. K. H. Subrahmania Iyer, A. D., Erode to Gobi to relieve Mr. Thangavelu.

Leave. Mr. R. Sankaran, Assistant to Cotton Specialist extension of leave out of India, 22 days half average pay plus 3 months 9 days half average pay "not due" from 30—8—36. Mr. M. Singara Rayan, Artist, l. a. p. for one month from 1—10—36. Mr. C. Raghavendrachar, Assistant, Chemistry Section, l. a. p. without m. c. for one month from 12-10-36. Mr. A. P. Balakrishna Nair, F. M., Kasargode, l. a. p. without m. c. for one month from 22-10-36 with permission to avail 22nd November. Mr. L. Kurma Rao, F. M., Anakapalle, l. a. p. for one month from 21-9-36 with permission to prefix 19th and 20th being public holidays. Mr. P. Gopalaratnam, Assistant, Guntur extension of l. a. p. for one month from 27-9-36. Mr. C. A. S. Ramalingam Pillai, A. A. D. extension of l a. p. on m. c. for one month in continuation of leave already granted. Mr. C. Raman Moosad, A. D., Ponnani l. a. p. for one month and 10 days from 26—8—36. Mr. P. P. Syed Mohamad, A. D., Somanur, l. a. p. for one month from 13—10—36. Mr. K. C. Thomas, A. D., Tiruppur, l. a. p. for 30 days from 25—9—36.

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Editorial.

Rural Uplift and District Economic Councils. The Madras Government have recently announced the apportionment to the various districts, of the 15 lakhs allotted by the Government of India for the work of rural construction to be executed during the current year. While doing so, they have rightly stipulated that the villages that are to benefit by the improvement schemes are to contribute, either in kind or coin, one third of the amount provided to them by the Government, and also suggested tentatively that these sums are to be devoted for the development of rural sanitation, water supply, loan and sale co-operative societies and communications. They have also called for further proposals regarding the utilisation of the grants and the running of the schemes from the district collectors and district economic councils about whose formation we referred to in our July number.

From a perusal of the proceedings of these councils so far as they have been reported, we note that the general plan of work seems to be to form divisional subcommittees who are to survey the conditions in their area and select suitable centres to serve as model villages where all the improvement schemes are to be concentrated. There is a tendency to divert almost all the amounts on items like construction of godowns, roads and culverts, village halls of latrines, and sinking of wells, which, though highly useful and essential in indirectly augmenting the villagers' residual income and improving their health, are impersonal in nature. It appears to us that no adequate stress has

been laid, except in the case of two districts, on the human and cultural aspect.

It is too well known that if any work of amelioration has to have a lasting effect, it has to be broadly based on a firm foundation of a will to improve. We have to profit by the lessons of experience taught by the working in the villages of the co-operative movement which suffered in the past for want of proper education and training of the members on questions relating to co-operation. If the drive for reconstruction is to be of permanent value, it is necessary to see that not only the curiosity of the villagers is roused, but also their outlook is widened, their aspiration elevated, and their leisure utilised for mutual help and corporate action, such that they may take an abiding interest in the several activities of the economic councils, abandoning their proclivities towards faction and never ending litigation. The Royal Commission on Agriculture in India realising fully the importance of this aspect of improvement, have emphasised on the idea of village guidance along with their recommendations for the material improvement of the agricultural population.

We feel, therefore, that one of the primary tasks of our district economic councils should be the creation, in the minds of the villagers, of a desire to lead a cleaner and better life, and of an interest to work together for the common welfare. It is essential in order to reach this goal early to employ an agency to train and guide them in the right direction. It is also necessary that such an organisation should be constituted from the villages themselves as anything external will have no rural touch and will not outlive long after the protecting hand of Government is removed. We cannot do better than invite the attention of the readers to the measures adopted at Bairampally by the Village Industries Association, South Kanara-a purely private body. They have divided the village selected for rural welfare work into ten blocks, each containing 20 to 25 houses, and entrusted each one of them to a member of a volunteer corps called '*grama sevakas*'. The members of this corps are elected from the villages and trained in all aspects of rural improvement work by holding special classes, prior to their being put in charge of blocks. The above system ensures local interest and is therefore worthy of adoption in all model villages.

We would also suggest that along with various proposals formulated by each council, sufficient provision may be made in their budget for the importation and breeding of milk yielding types of goats—in some cases buffaloes too—and for the rearing of fishes in all ponds, wells and tanks, with a view to improve the nutritional side of the village population. Arrangement may be made with the Revenne departments for the planting of trees like *Gliricidia maculata*, *Pongamia glabra*, *Poinciana elatra* (Vadanarayanan) on the bunds of lakes, channels, (Pungam) drainage canals, and enjoyment of their leaves for green

manuring purposes. Adequate attention will also have to be paid for the collection of all decomposable material lying neglected in the village sites, field bunds, poramboke lands, and for their conversion into compost, the incorporation of which will be of immense value to all Indian soils.

Reduction of Railway Freight on Cattle. We are gratified to observe that the huge differences in the number of wagons carrying cattle to and from Bombay every year have created a stir in the minds of such an influential body as the Indian Merchants Chamber, Bombay. Its working committee estimates an annual loss of 20,000 calves and 20,000 dry cows in the city of Bombay due to want of sufficient space in the cattlesheds and to prohibitive railway freight which preclude the cattle owners from rebooking the animals that have gone dry back to the country side. We wish to add that the conditions obtaining in the city of Madras are not in any way brighter. Hundreds of valuable cows are being imported every year from Nellore, and these never return home when they no longer serve the purpose for which they were brought. The high cost of fodders, the expensive accommodation at Madras, and the heavy railway freight to the nearest grazing area which is more than 100 miles from the metropolis, compel the milk-men of Madras to part with their erstwhile wage earners at a nominal price mainly to the slaughter houses. We consider that the request of the Committee of the Indian Merchants' Chamber to the Railway Board to lower the freight of cattle booked to and from the big cities and towns is a welcome one, and has come none too soon in the day.* We feel sure that our agriculturally minded Viceroy will, with his profound interest in the improvement of cattle in India, spare no efforts to maintain the existing good milk breeds from being reduced to small numbers. We rejoice to learn that at the instance of the Viceroy the Railway Board were pleased to show recently considerable concession in railway freight for dry cows exported from Calcutta. This response gives us hope that the same concession will be extended by the Railway Board to all other chief cities in India.

Announcement.

We are glad to announce that Mr. G. R. Hilson, formerly Director of Agriculture, Madras and one of our oldest members, has very kindly offered to become a patron of the Union. We hope that this good example and large heartedness will be emulated by many of our members and subscribers.

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* Since writing the above we are glad to note that the Madras Provincial Marketting Board have made similar recommendation on the reduction of the railway freight on cattle.—*Editor*

STUDIES IN SUGARCANE II **

Performances of canes as influenced by environmental conditions.

BY T. VARAHALU, B. A., M. Sc.,

Agricultural Research Institute, Coimbatore.

Introduction. The protection granted to sugar industry afforded a fresh impetus for a closer and more intensive study of the several problems relating to sugarcane and its products. One of such problems that is considered of importance is an investigation into the possibilities of extending the existing short milling season, thereby to provide a longer working period for the sugar factories. If one has to make any recommendation in this direction, a knowledge of the behaviours of different cane varieties under the several changing seasonal conditions in different localities is of primary importance.

With a view to study integrated effect of the climatic and the seasonal factors on the growth of cane and on the composition of its juice, a large number of cane varieties like seven sugarcane—sorghum crosses Co. 351 to Co. 357 and cane types Co. 213, Co. 281, Co. 285, Co. 290, J. 247, P. O. J. 2878, and purple Mauritius, were planted every month from September 1932 upto August 1933, on six Agricultural Research Stations, viz., Anakapalli, Samalkot, and Maruteru in the Northern districts and at Coimbatore, Aduturai and Palur in the Southern districts of the Presidency. The actual number of varieties planted on each station however differed.

The canes were periodically analysed and at the time of each analysis data in regard to the average weight, length, girth and the number of internodes for each variety were collected to follow the vegetative development of cane in relation to the chemical composition of its sap (cane juice).

As the bulk of the data collected was very large, it is proposed to deal with it in two parts, viz., (i) the general tendencies of canes as influenced by season and locality and (ii) the detailed examination of the individual varieties under different conditions with a view to explore the possibilities of extending the present short milling season. The present communication deals with the first part. As all the varieties tried exhibited striking similarities in their general behaviour, the variety Co. 352 is chosen for illustration, as this is one of the varieties common for all the stations.

In a previous communication (Viswanath, Ramasubrahmanyam and Varahalu, 1933) results of some preliminary studies in this

* Paper accepted for Ramasastrulu—Munagala Prize, 1936.
* Visvanath B, et al. The Indian Journal of Agricultural Science, Vol. IV, Part I, February, 1934.

direction were reported. Therein, a brief statement of the chemical studies on the ripening of sugarcane—sorghum hybrids planted in the months of March, April, June and September of 1932 were considered. The results of studies embodied in the present paper constitute an extension of the same.

I

Comparative rainfall and general climatic conditions at the six stations:—The data of monthly rainfall and of the rainy days on the six stations during the experimental period are represented diagramatically (Plate I). The differences in the rainfall conditions as revealed by this are not accidental to the experimental period, but are fairly general.

From the data the following points become clear:—

(1) At all the stations, excepting Coimbatore, the average annual rainfall is nearly the same, only the manner of its distribution is different. At Anakapalli, Samalkot and Maruteru, the greatest portion of the total rainfall for the year occurs during the South West monsoon period, June to September, when the days are long, the nights short, and the weather is generally warm. Thus at these stations a plentiful supply of water, high atmospheric humidity, and greater warmth and sunshine, all the factors conducive to good vegetative growth obtain during this period.

At Aduturai and Palur on the other hand the conditions are the reverse. The period of heavy rainfall—North East monsoon period—synchronises with comparatively cooler months, when the days generally tend to get short and the nights long.

2. The dry period generally commences at Palur and Aduturai only from late January, whereas at the stations in the Northern districts it begins even a month earlier, and extends in all cases upto March. This period is throughout cool.

3. While the hot weather period from April to June is common for all the stations, the following warm months July to September are generally comparatively less humid with less rainfall at Aduturai and Palur, unlike at the stations in the northern districts, Anakapalli, Samalkot and Maruteru. Thus at Aduturai and Palur, unlike at the other places, there is more or less a continuous period of hot or warm months, April to September, with comparatively less of rainfall.

4. It may be mentioned here that the number of rainy days either for the whole year or for any part of it being comparatively less, it is in effect the conditions which obtain during the rainless days which form the greatest part of the year, that go more to tell upon the performance of crops. The easy availability of water, and the degree and duration of the atmospheric humidity caused by the rainfall, only serve either to modify or reinforce the effects of the season.

As will be seen later, these differences in the relative distribution of rainfall and the dry periods at the several stations are reflected in the performances of canes.

II

Some factors influencing the growth of cane and the concentration of juice:—In this section it is proposed to study the influence of the external seasonal conditions on the vegetative growth of sugarcane and on the concentration of its juice. For this purpose the vegetative growth of canes as represented by the progressive height measurements, and the periodical variations in the concentration of juice as represented by the brix values (Table I) are followed. For illustration the data for the variety Co 352 at Anakapalli are chosen. The data are represented graphically (Plates 2 and 3). The periodical variations in the concentration of juice are shown separately for each of the crops planted in the several months (Plate 3 A). The graphs pertaining to individual crops are juxtaposed to bring out the integrated effect of the climatic and the changing seasonal conditions on the concentration of the juice. The curve represented by the broken line (Plate 3 B) illustrates the general trend of the progress of concentration during the several seasons of the year.

Comparing the growth curves with the concentration curves the following points are noticeable:—

1. The growth curves are very steep during months from June to September—October indicating vigorous vegetative growth. It was already mentioned that the seasonal and the weather conditions during this period are the most favourable for growth, as there obtain plentiful water, high humidity and greater warmth and sunshine.

2. During the months from June to October when the growth curves are steep, the concentration curve is showing a trough, thereby pointing that during this period the balance of solids in the sap is very low and that all the material synthesised is used up as quickly as it is formed in the building up of the vegetative tissues.

Thus the concentration of the juice tends to be a minimum when the growth tends towards a maximum.

3. The slopes of the curves from the month of October onwards indicate that all the crops are tending to slow down in growth from about this time of the year. The curves actually become flat, and continue to be so from about November—December to April—May. This period coincides with the one covered by the steepest part of the concentration curve, and the maximum concentration is attained at a time when the stationary part of the growth curve ends. Thus from October onwards, all the crops irrespective of their times of planting hasten to enter upon another phase of their life's activity, viz., that of quickly enriching the concentration of their juices.

Now, it is generally cool and the rainfall less from October onwards, unlike in the period immediately preceding it. The period from November—December to April—May can be split up into two parts:

(a) December to March, and

(b) March to May.

The first part of the period is characterised by being (i) clear and bright (ii) cool and dry, and (iii) windy. Further, the nights during this part of the year are long and the days short. The second part is characterised by (i) being hot with comparatively high temperature both during day and night, (ii) having a bright sunshine for a large number of hours in the day and (iii) inadequacy of water and low humidity. All these conditions tend to cause the loss of moisture and arrest growth.

From this it becomes clear that for quick accumulation of solids in the juices and for the attainment of full maturity, cool and dry conditions followed by increasing warmth are essential, and it may be expected that whenever such conditions prevail, the crop hastens to accumulate solids, irrespective of the state of its development at that time.

5. Again, two maxima are indicated in the concentration curves of different magnitudes. What is interesting is that both the maxima occur during about the same part of the year, thereby emphasising upon the greater potency of the season in controlling the concentration development in the cane juice. The differences in the magnitudes are owing to differences in the vegetative preparedness of the crops at this time of the year.

Thus, whatever be the stage of growth of cane, with the onset of proper seasonal conditions the crops hasten to enter upon the phase in its development which tends to lead on towards maturity.

6. While the tendencies considered so far are general, the crops planted in the several months show striking differences among themselves, as evidenced by the relative positions of the growth curves. It is easy to see that all those crops which had enough time to establish themselves before entering upon the period from June to October made good vegetative progress. When this time was insufficient, the vegetative growth suffered correspondingly.

From the foregoing it would appear that in the cycle of the seasons of the year, there is a season specific for the development of each one of the phases in the life of the cane. There is a season during which the vegetative growth alone is promoted more, and another during which the growth is arrested and the concentration of the juice is enriched quickly at greater rates until final maturity is attained. On any cane crop which passes during these seasons their

independent effects are impressed, and the degree of the impress of each season is conditioned mainly by the state and the preparedness of the crop to receive it at that instant. The performance of the cane at any given time in the year is thus a resultant of the effects of (i) the several seasons through which it passes, (ii) the preparedness of the crop, and (iii) the inherent capacity of the cane. This latter aspect will be considered in a separate part as was already indicated.

It will be seen that all these general observations find confirmation from the detailed analytical data to be examined hereafter.

III

Examination of the analytical data. As the canes are planted in several months, they should obviously be of different ages, on any day of harvest or analysis. Therefore the performances, at any given time, of these crops, planted in the several months should go to indicate the influence of the seasonal conditions which happen to prevail at that time, and perhaps for some time previously, irrespective of their ages. For illustration, the brix values representing the concentrations of juices (Table I) are plotted against their respective ages (Plate 4).

(a) *Concentration of juice as influenced by season.* An examination of the data and of the graphs leads to the inference that irrespective of the age of the crops on any one day, the juice of cane generally indicates almost the same degree of concentration.

Barring minor differences due to differences in location and other causes, all the graphs in each station showing the brix values run almost parallel to the age axis. Again, the several graphs in each station range themselves in regular stairs one above the other. In the more advanced months of the period from June to April, the levels of the graphs are in general progressively higher in the scale of brix values.

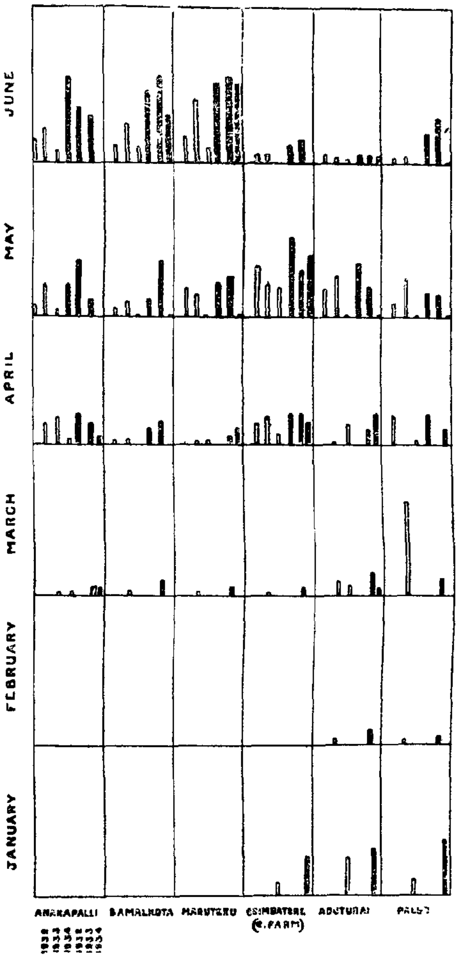
Thus it becomes evident that so far as the concentration of the juice is concerned, as measured by the brix values, the most potent factor which goes to influence it is the climatic or the seasonal conditions which obtain at the time of harvest, and not the mere age of the crop as is ordinarily supposed. During the period when cool and dry conditions prevail, and when high temperatures obtain, the concentrations are fairly good, and during the rainy months they are very poor.

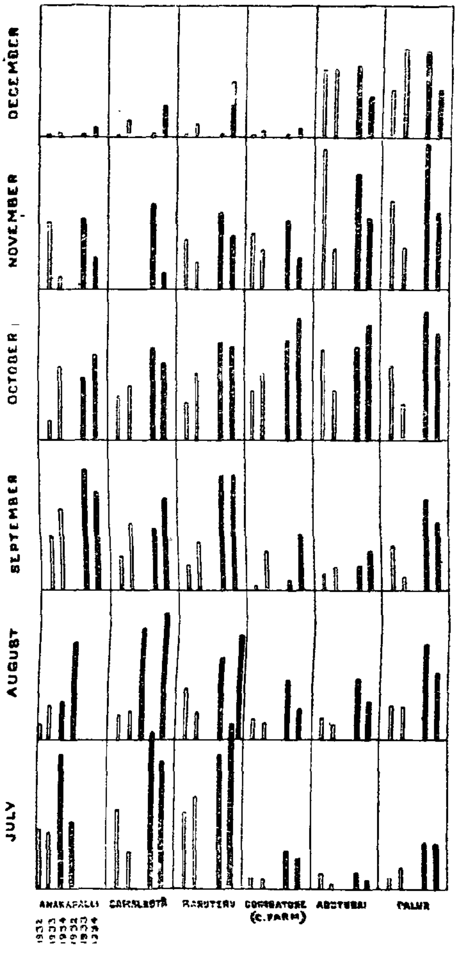
Although the concentrations as seen here are very similar at any one time for crops of different ages, the several crops seem to differ in other respects. The July planted crop for example, has comparatively lower weight, and lower values for T/B (Brix of juice from top half/ Brix of juice from Bottom half) ratios. These differences will be considered presently.

(b) *Relation between the age of the crop and the performance of the cane.* There appears to prevail a general belief that if a cane crop

PLATE I.

Rainfall distribution during the Experimental Period.





= Rainfall in inches.

= No. of Rainy days.

Plate II. GROWTH OF CANE

CO. 352 ANAKAPALLI

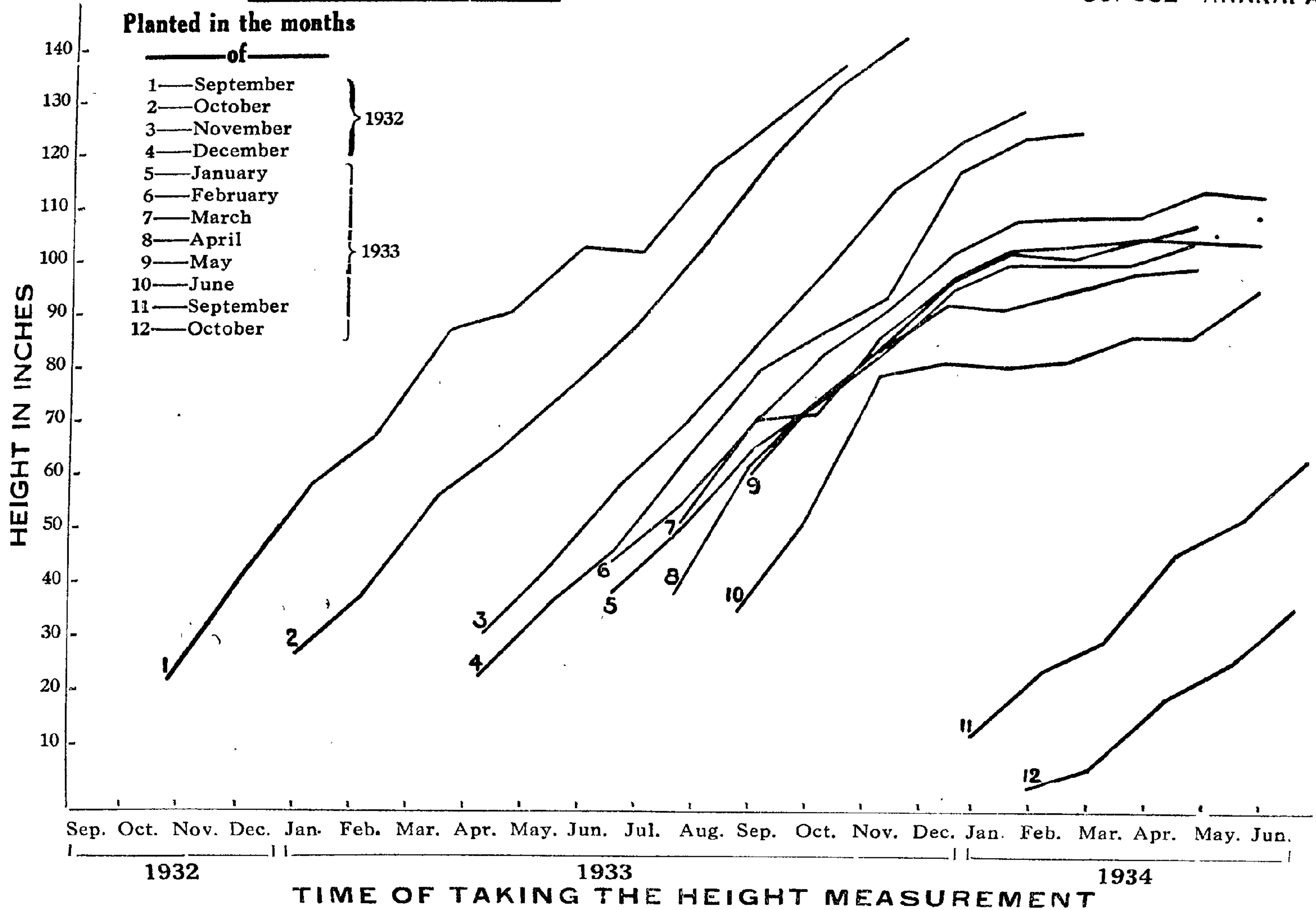
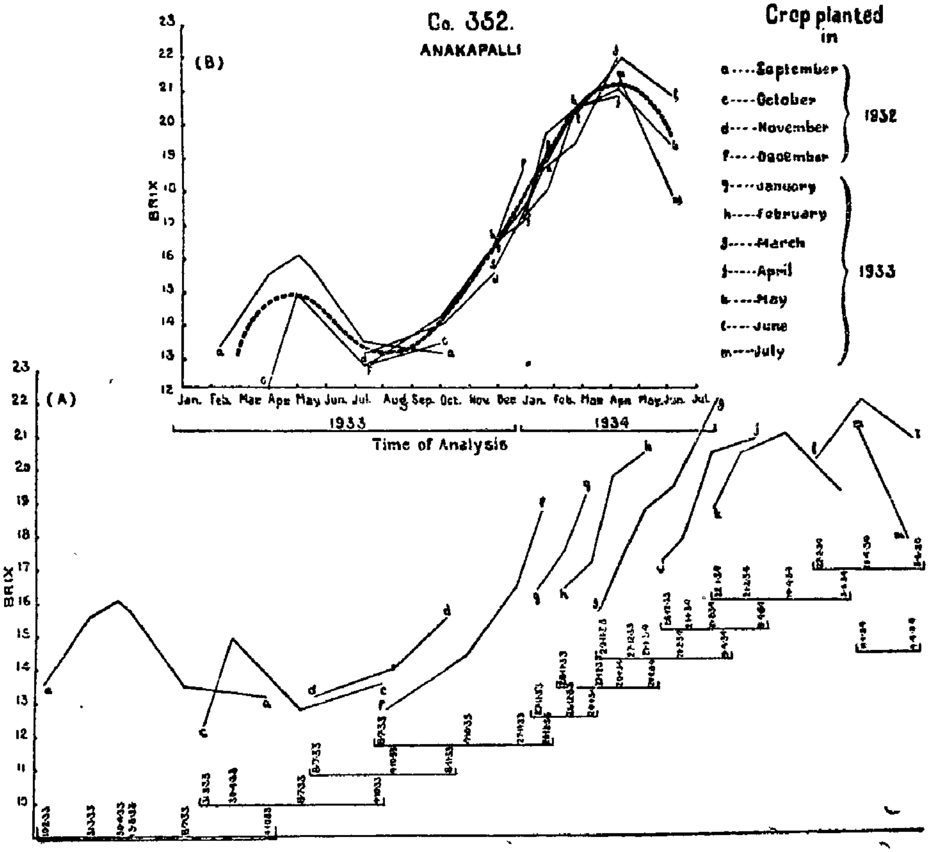


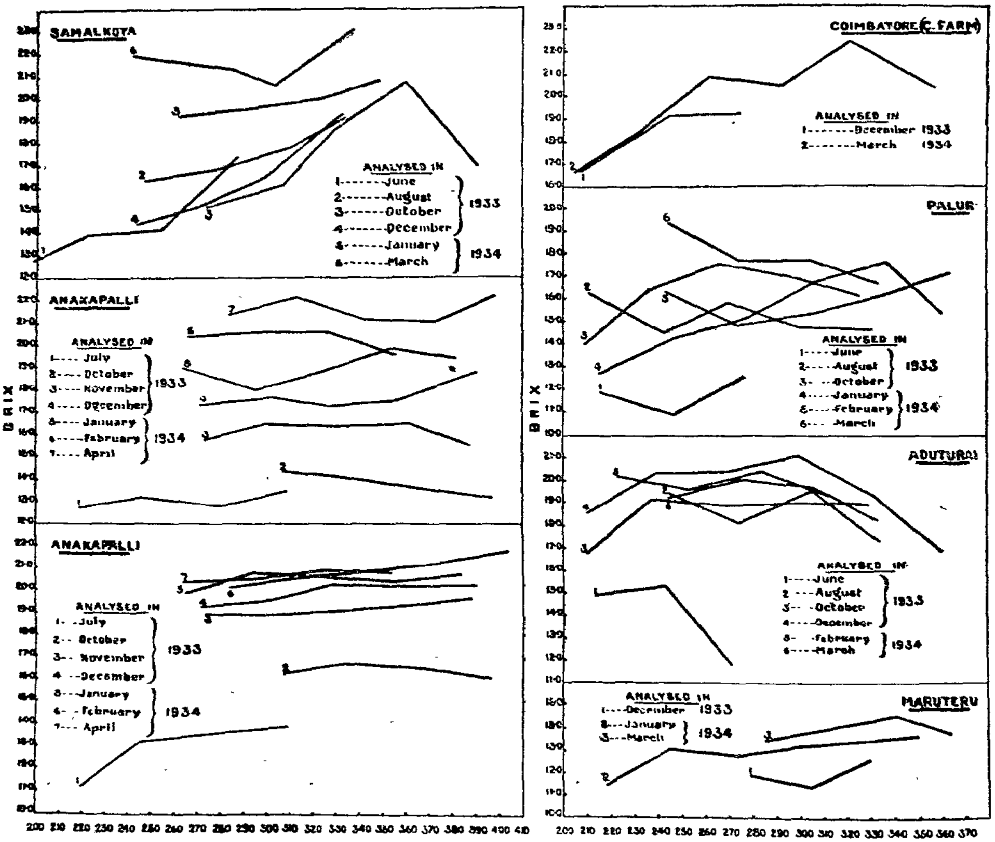
PLATE III



Periodical variations in the concentration of the juice.

PLATE IV.

Influence of season on the concentration of juice.



Age of crop in days.

grows about a year, it will ordinarily be fit for harvesting. In what follows an attempt is made (i) to verify the tenability of this belief, and (ii) to know whether it is merely the age of the crop which controls the maturity of cane, or other factors concomitantly influence it.

As canes are planted in different months of the year and analysed periodically, it is possible to get canes of equal ages at different times of the year. Although such canes are of nearly equal ages, they obviously differ from each other in that, that before attaining to that age, they must have passed through widely different seasons during the year. The analytical data of canes of equal or nearly equal ages are grouped together and presented in Table II. A careful perusal of the data presented shows that mere age of the crop is not a criterion or a measure of its maturity. The seasons of the year through which a crop passes during its stand, the particular order in which it faces them, and the duration of its stay in each one of them, appears to have a stronger bearing on its performance than merely its age. The performances of canes at some typical ages are considered below:

Cane crops 210—220 days old. At this age of 7 to 7½ months the crops are no where near maturity, irrespective of the time of planting. Among themselves the lower concentrations are generally indicated by all those crops which are analysed during rainy months. The general level of concentration is also low at this age, the brix values ranging from 12—16. The T/B ratios are also very low (0·73—0·90), indicating extreme states of immaturity.

Cane crops 235–245 days old. At Samalkot the crop planted in December and analysed in August is poorer by 5—6 units in concentration (brix: 14·4) than the crops planted in July and analysed in March (brix: 21·9), although both are of the same age. The latter however have only half the average weights of the former, the weights being 1 lb. and 1·9 lbs. respectively. The April planted and the December analysed crop also shows similar differences.

At Anakapalli, the crop analysed in April has a better average weight per cane than what was planted in November and analysed in July, the respective weights being 2·3 lbs. and 1·2 lbs. The compositions of juices in both cases are poor. But between the two the April analysed crop is comparatively much better both in purity and in concentration. (Purity: 79·43 & 73·34; and Brix: 16·1 & 13·2 respectively.)

Again, at Aduturai, the July planted crop is at its best in March in respect of its composition, while the average weight of the cane is poor (Av. wt.: 0·90 lb. & Brix: 19·5; Purity: 88·0; & T/B: 0·97).

The crop planted in December and analysed in August has also a high brix (19·5) and high purity (88·0) but very low T/B ratio (0·90). The crops analysed in October and December also indicated immaturity.

Cane crops 250—265 days old. At this age of about 8½ to 9 months the differences in the performances of canes planted in the different months are more strikingly exhibited than at the younger ages. All those that are analysed in May, June and December show high purity (82—85) but have extremely low T/B ratios (0·83—0·88). As such they cannot be taken to be quite mature. Their concentrations are also generally poor. (Brix: 14—17).

Cane crops 276—285 days old. At Aduturai the crop planted in the middle of May is very ripe at this age as revealed by the analysis done towards the end of February (Brix: 20; Purity: 89·8; T/B: 1·03). At Anakapalli, the two crops, the one planted in October and analysed in July, and the other planted in July and analysed in April, exhibited marked differences. In the one case the composition was poor and the average weight of its cane is comparatively much higher, (Brix: 12·89 and Wt.: 1·70 lbs.), while in the other it is the reverse, (Brix: 21·3 and Wt.: 0·95 lbs.). At Samalkot the September planted and the June analysed crop, and the crop planted in June and analysed in March, exhibited similar differences. Differences of like nature are also to be seen among crops at Maruteru.

Cane crops (286—296) & (297—307) days old. When planted between March and May the cane appears to come to full maturity in about 9½ to 10 months. The poor analyses recorded are all for those crops which are planted in the months of August, October and December and analysed in August and October. Between the performances of canes in August and October at Aduturai and at the stations in the northern districts, there are wide differences, and these are in favour of Aduturai. It will be noted that between August and October, the conditions at Aduturai are comparatively more favourable for the cessation of growth and for leading the cane towards maturity. This point will be referred to again later.

Cane crops 360 days old and above. To take a typical example, the analysis of the crop planted at Anakapalli in September 1932, and analysed in October 1933 is very poor even after standing for 14 months (Brix: 13·2), while it has a very high average weight per cane (3·55 lb.) A crop of the same age but planted in the month of March and analysed in the month of April of the subsequent year stands in striking contrast. It has half the average weight of the first (1·53 lbs.) and nearly double its concentration, (Brix: 22·2).

All other data also show similar differences in their performances in spite of their advanced ages.

Thus the data discussed appear to point to the following:—

1. Mere age of the crop without reference to the time of its planting affords no indication of its maturity.

2. It is not only the age, but more potent than this in controlling the performance and the maturity of a cane, are the seasons of the

year through which the crop passes during its stand, the order in which it faces the several seasons, and the duration of its stay in each one of them.

3. Depending upon these differences, in crops of equal ages, either vegetative growth alone is promoted in some, or improvements in the concentration of the juice alone are caused in others. In properly timed plantings, normal development, both in vegetative growth and in concentration, takes place.

4. These observations lead to the necessity for a proper choice of the time of planting and of harvesting with reference to the seasons and the rainfall conditions which obtain in any given locality.

IV

Differential behaviours of canes planted in several months on any one station, and on different Stations. The detailed analytical data of the several plantings on the six stations are tabulated and appended, (Table 1). An examination of the data reveals that the crops planted in the several months, while exhibiting a similarity of behaviour in their general tendencies, showed among themselves marked differences in their performances. The differences in any one station are exhibited in a number of ways, viz., in the matter of the progress of (a) vegetative growth as shown by weight and height of cane, (b) concentration of juice as evidenced by brix value, and (c) quality of juice as indicated by the values for the purity, glucose, glucose ratio and T/B ratios. Again, the performances of canes planted in certain months on the stations at Aduturai and Palur on the one hand, and at Anakapalli, Samalkot and Maruteru on the other, differ markedly in important respects, consequent on the differences, as already noted, in the sequence and durations of the seasons and conditions obtaining on the two sets of stations.

a) *Vegetative growth:* At the stations in the Northern districts for example the following points are observable:—

1. With increase in age the average weight of cane is steadily increasing during the months after May upto October—November. In all the crops the weights do not indicate any considerable increases from November onwards to April—May, in spite of advancement in ages. These observations on the weights of canes comfirm those made earlier from a consideration of the growth curves that during June to October growth is promoted more, while it is arrested from about October to April—May.

Again, the crops planted from September to December of 1932 made a more rapid progress in growth during the South West monsoon period of 1933 than those planted in the months from January to July of 1933, during the same period. Even among the latter plantings themselves, the growth was somewhat progressively diminishing, the growth put on by the July planted crop being the least.

Obviously, the rate at which the vegetative progress is made, even during periods when conditions most favourable for it are prevailing, depends upon the prior preparedness of the crop by way of previous establishment to take advantage of these conditions.

b) *The progress of concentration of juice*: In all the crops tendency is noticeable that the concentration is moving towards a maximum by the month of April. Even much earlier than April, the crops planted from January to April of 1933 attained a fairly high level of concentration late in January of 1934. Not only this, they further continued to improve both in magnitude of concentration and in the quality of the juice.

The May and the June planted crops showed higher levels of concentration in February and March. Judged by their performances in February, it would look as though that they would have also fared well in January, like the previous ones, at ages of 8 to 8½ months.

The July planted crop was good and in fact was at its best in composition in April at an age of about 9½ months. Like the May and the June crops, it might also be expected to show a fairly high degree of concentration a fortnight or two earlier at an age of about 8 to 8½ months, in March.

Although its composition taken by itself is very good, it differs from those which preceded it in that it has very low weight and very low T/B ratio, indicating that if this cane is crushed even in the month of April, the yield of cane would be less, and that the top half of even this small cane would be very immature, and so would adversely affect the quality of the composite juice.

The September and the October planted crops also tended to show a maximum brix by about April—May at ages of about 8—8½ months, as was already noted. But the performances of these crops differed from those of the plantings made from January to June in the following respects:—

(i) The magnitude of the maximum itself is less,

(ii) The quality of the juice is poor, and

(iii) Even this maximum value did not remain at that level for long. It quickly fell hardly standing even for more than a month, whereas in the rest considered so far, a high brix value was not only attained early in the season, but they also went on improving further for more than 2½ to 3 months, the period decreasing in all the later plantings.

Thus the September and the October plantings could not show at the ages of about 8 to 8½ months what the crops planted from May to July could show at similar ages far as the quality of the juice is concerned, these crops showed more pronouncedly what the July planted crops tended to indicate in the month of April.

The November and the December planted crops were too young to show even this tendency in the crushing season immediately following their planting. These considerations show that while the influence of the season in controlling the juice concentration is fully exhibited as revealed by the brix values, yet it appears essential, as evidenced by the data here considered, that the crop has to put on certain minimum amount of vegetative growth to be able to take full advantage of the favourable conditions of the season, and that this minimum is attained only by the crops planted from January to June. The rest of the plantings are defective either in weight, or in concentration, or in quality of juice, or in all these respects, in the milling season immediately following their planting.

Again, comparing the behaviours of the November and the December planted crops, it will be seen that in the month of December of the subsequent year, at ages of about 13 to 14 months, they exhibited a fairly high level of concentration. The quality of the juice and the T/B ratios were good. Further, they possessed the additional advantage of a good average weight for cane. Now, December is the earliest part of the period favourable for improvements in concentration to take place. How the September and the October planted crops would have also fared, had they also been allowed to remain till December of the subsequent year, it would have been interesting to follow, but no analysis was however made. From the foregoing considerations, it would appear that those canes, which are vegetatively fully prepared, by the time the seasonal conditions favouring concentration of juice occur, are the first to take advantage of these conditions. It would also become evident that the mere attainment of a high degree of concentration does not always connote an equally high degree of quality in the juice. The improvements in quality follow the improvements in concentration, as indicated by the brix values.

Again, comparing the performances of canes on the three stations in the Northern districts, representing one tract of the presidency, one sees that while at Samalkot and Maruteru the several crops behaved almost similarly as they did at Anakapalli, the crops on these two stations, were comparatively much better throughout both in weight and in concentration and quality of juice. These differences in all corresponding crops are probably attributable to the differences in the local conditions of soil.

Comparative study of the several plantings made in the northern and southern districts. The general behaviours of the plantings made from January to May and also partly in June on all the six stations are very similar.

2. The plantings made in other months, especially in months from September to December showed marked differences probably

consequent upon the differences in the conditions obtaining on the two sets of stations.

3. The average weights for individual canes at Aduturai and Palur are very low. Between these two stations in the south, those at Palur are higher. The weights of canes for corresponding crops grown at Anakapalli, Samalkot and Maruteru, are very high. For example the weights of canes grown at Anakapalli varied from 2·0 to 3·0 lbs, while those raised at Aduturai ranged from 0·34 to 0·62 lb.

4. So far as the cencentrations of the juices are concerned, even by the month of August all the plantings made from September to December indicated at Aduturai considerably higher values. At this place, at ages of 11, 10, 9, and 8 months they showed the following ranges of values: brix: 17·3 to 19·6; purity: 84 to 89; T/B raio: 0·88 to 0·91. These latter values however indicate immaturity, In the crops at Palur, the purity values ranged round about 81, and the T/B ratios varied from 0·95 to 1·0.

At Anakapalli and Samalkot on the other hand the positions were the reverse. The concentrations were considerably lower in the month of August, the brix values for all the crops at Anakapalli being below 15, and the values for purity being between 70 and 80. The T/B ratios also were low. At Samalkot too, similar low values were noticeable. (Brix: 14–16: Purity 67–78; T/B: 0·78–0·82).

5. While at Aduturai and Palur between the analyses in June at the age of 9, 8, 7, and 6 months and again in August at ages of 11, 10, 9 and 8 months there were invariably observable improvements in concentration by big jumps, by about 4–5 units at Aduturai, and by 3—4 units at Palur, it will be seen that at Anakapalli and Samalkot there is particularly no improvements in concentration taking place during this period. Similar improvements in big strides however are noticeable at these latter stations during periods after August onwards as already mentioned.

6. Between June and August at Aduturai and Palur, the glucose ratios fell considerably lower, indicating a better improvement in quality of juice, while at Anakapalli and Samalkot, they were throughout comparatively very high. In the first two stations the values fell from (0·98—2·0) in June to (0·1 – 0·4) in August, indicating improvements in quality. At Anakapalli and Samalkot, these values were throughout very near 1·0 and of the two stations, they are more conspicuously so at Anakapalli.

7. Again, between the June and the July planted crops at the two groups of stations, similar differences are noticeable. The values for glucose contents of juices at Aduturai for these crops during the

months of February, March and April, are considerably lower, being less than a third of those for the corresponding crops at Anakapalli.

8. Again, for the July planted crop, T/B ratios are very low at Anakapalli indicating immaturity during months when these crops at Aduturai were showing high values, very near unity, indicating maturity.

All these differences in the behaviours of corresponding crops on the two sets of stations are easily explainable on the basis of the difference obtaining in the seasonal and the rainfall conditions on these stations, which were considered in an earlier section.

VI

Thus far, the differential behaviours of the canes as influenced by the seasonal conditions on the several stations were considered and their similarities compared. It will be seen however that there occur occasionally certain apparent contradictions to the general observations made in respect of the variations in the concentrations, It may be noted that such exceptions occur only during periods of transition from season to season. This is owing more to the inertia in their readiness or capacity to adjust and respond to the changing conditions. The degree of the inertia exhibited varies with variety, e.g., of the two varieties Co. 351 and Co. 352, representing respectively the early and the late types, Co. 351 responds more quickly, while the other exhibits greater inertia. These and other similar differences in the behaviours of the same variety, and of different varieties, will be considered in a separate communication. It is enough for the present to say, that any contradictions or exceptions noted are only apparent, are but particular cases of a general phenomenon which has been considered in this paper in its broad outline.

Summary and conclusions: 1. The performances of a number of sugarcane varieties planted during 11 months of the year from September 1932 to July 1933 at six stations in the presidency, were followed, at several stages of their growths and the general tendencies revealing the integrated influence of the seasons on their performances were discussed choosing Co. 352 as a type.

2. Rainfall and seasonal conditions in the different localities are studied, and correlated with the differential behaviours of the canes in the several localities.

The research stations in the Madras Presidency appear to be classifiable as (i) the Circars group, and (ii) the Southern group, according to the prevalent climatological conditions. The Circars group appears to enjoy a sequence of climatic factors more favourable for the growth of cane than the southern group. Canes planted in certain months at

the two different groups of stations therefore exhibited differences in their behaviour. In tracts which Aduturai and Palur represent, it looks as though that the period from August to October is useful additionally for harvesting purposes.

3. From this study it would appear that sugarcane has four major phases in its life cycle: (a) establishment, (b) growth, (c) elaboration and accumulation of the necessary raw materials and (d) final ripening or maturity. There are a set of seasonal conditions specifically favourable for each of these phases in the development of cane. The conditions occur in different months of the year in different localities.

There are no clear cut lines of demarcation between these several phases of activity or between the times when these conditions favourable for these activities occur. They in fact overlap. All the processes take place simultaneously at any given time, but only at varying rates: the process most favoured by the particular seasonal conditions takes place at the greatest speed and the rest only more slowly at that time. The performance of a cane crop at a given instant is thus the resultant of the effects of the several conditions operating on it at that instant.

For any cane crop to come up normally and yield good results, the time of planting must be so chosen with reference to the sequence of the seasonal conditions in any given locality, that the crop is enabled to pass through the several phases in its life cycle in the order indicated, and stay for sufficient time in each one of the seasons favourable for these phases of activity.

Any deviation in this order, or any undue shortage of stay in any of these seasons, imposes a handicap on the crop to the extent of such deviation or shortage of stay. These deviations affect either the vegetative development, or the concentration, or the quality of the juice, or all these.

4. A minimum of prior vegetative growth appears to be an essential condition for the crop to take advange of the seasonal conditions favourable for either good vegetative growth or for improvements in concentration.

5. The concentration of juice tends towards a minimum when the vegetative growth tends towards a maximum. The concentration tends to improve in rapid strides to attain a maximum, when the growth tends to stop.

6. The age of the crop is by itself no criterion of its maturity as is ordinarily believed, for the reason that the sequence of the seasons during which its life cycle is spent, has more effect on its growth, devevlopment and ripening, than age.

7. The concentration as expressed by brix values does not always appear to indicate the quality of juice. Improvements in quality follow improvements in concentration.

8. A cane crop can be allowed to stand for a period of about three months after maturity without deterioration setting in, but the period is shortened with the incidence of hot dry weather.

Plantings made very late attain high concentration only very late in the season favourable for the process. Further, they also quickly fall off.

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Table I.

Age of crop at time of analysis. days.	Date of analysis.	Average weight of single cane. lbs.	Brix %	Sucrose %	Glucose %	Purity %	Glucose ratio.	Top/Bottom ratio.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Anakapalli. Co. 351. (Field No. 2).				
				September 1932 planted crop.				
161	10—2—33	0·87	14 37	9·88	1·75	68·77	17·69	0·69
210	31—3—33	1·33	15·38	12·54	0 91	81·55	7 22	0 82
240	30—4—33	1·45	17·07	14·71	1·50	86·20	10·16	0·83
253	13—5—33	2·05	16 54	13·92	1·34	84·14	9·65	0·87
309	8—7—33	2·12	13 90	11·12	1·70	80·00	15 29	0 90
397	4—10—33	2·85	16·10	12·64	1·35	78 52	10·68	1·00
				October 1932.				
181	31—3—33	0·82	10·55	7·28	1 99	69·0	27·34	0 60
211	30—4—33	1·28	14·27	10·57	2·54	74·1	21·02	0·73
280	8—7—33	1·64	13·60	10·66	1·70	78·4	15·95	0·83
368	4—10—33	2 55	16·57	13·48	1·16	81·4	8 61	0 94
				November 1932.				
245	8—7—33	0 86	13·2	9 67	2·22	73 24	22 94	0·97
333	4—10—33	1 59	16·77	13 47	1·32	80 30	9 80	0 87
388	28—11—33	1·60	19·68	18·26	0 61	92 76	3 34	1·00
				December 1932.				
219	8—7—33	0·76	11·18	6 53	2·48	58·42	35·80	0·79
307	4—10—63	1·43	16 27	12 64	1·61	77·71	12·74	0·85
361	27—11—33	1·60	19 31	17·87	0 86	92 53	4·81	1·02
390	26—12—33	1·60	20·24	18·52	0·29	91·52	1·56	1·03
				Anakapalli. Co. 352. (Field No. 2).				
				September 1932.				
161	10—2—33	1 02	13·37	8·68	0·91	64·90	10 53	0·79
210	31—3—33	1·88	15 68	12·52	1·13	79 85	8.91	0 80
240	30—4—33	2 30	16·09	12·75	1·55	79·43	12·16	0·79
253	13—5—33	2·43	15·74	13·47	0 92	85·59	6 86	0·84
309	8—7—33	3 10	13·50	10·90	1 42	80·74	13 00	0 96
397	4—10—33	3·55	13·18	9·04	1·79	70·24	19·81	1·14
				October 1932				
181	31—3—33	1·05	12·25	7·71	1·32	63·00	17 08	0·71
211	30—4—33	1·63	14·97	10 85	[illegible]·54	72 20	23 35	0 78
280	8—7—33	1·74	12·80	10 03	2·22	78 30	22 12	0 86
368	4—10—33	3·23	13·52	9·24	1·16	64·40	12·55	0 93
				November 1932.				
245	8—7—33	1·15	13 20	9·67	2·68	73·30	27·76	0·80
333	4—10—33	2·00	14·12	10·07	1·35	71·30	13·40	0·90
388	28—11—33	2 00	15·56	13·99	0 98	89·93	7·02	1·02
				December 1932.				
219	8—7—33	1·10	12·80	9·18	2·22	71·71	24·16	0·95
307	4—10—33	1·86	14·37	11 17	1·25	77·71	11·19	0·89
361	27—11—33	2 20	16 49	15·40	0·61	93·40	3 96	1·04
390	26—12—33	2·20	8·81	16·94	0 39	90·07	2·29	0·98

TABLE I (*Continued*.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Anakapalli. Co. 352. (Field No. 2-A).					
			January 1933.					
328	27—11—33	1·0	16·36	14·67	0·73	89·7	4·97	0·99
357	26—12—33	1·3	17·61	15·80	0·45	89·7	2·81	1·03
381	26—1—34	1·35	19·34	17·67	0·29	91·4	1·64	1·02
			February 1933.					
299	27—11—33	1·50	16·49	15·16	0·85	91·9	5·62	1·02
328	27—12—33	1·40	17·24	15·10	0·75	87·6	4·99	1·05
353	20—1—34	1·60	19·84	18·11	0·30	91·3	1·65	1·05
384	20—2—34	1·52	20·55	17·94	0·50	87·3	2·80	1·07
			March 1933.					
2·3	29—11—33	1·50	15·83	13·73	1·00	86·7	7·29	0·97
301	27—12—33	1·38	17·64	15·34	0·68	87·0	4·43	1·03
326	21—1—34	1·56	18·94	17·36	0·53	91·6	3·11	1·04
356	20—2—34	1·36	19·55	17·10	0·77	87·48	4·52	1·05
404	9—4—34	1·53	22·19	19·93	0·45	90·10	2·26	1·08
			April 1933.					
271	28—12—33	1·34	17·31	14·66	1·09	84·70	7·42	1·01
295	21—1—34	1·02	18·04	15·53	0·83	86·10	5·36	1·05
326	1—2—34	1·67	20·58	18·52	0·41	89·99	2·21	1·09
374	9—4—34	1·54	21·07	19·01	0·69	90·20	3·63	1·05
			May 1933.					
264	22—1—34	1·34	19·04	16·91	0·48	88·8	2·86	1·02
294	21—2—34	1·47	20·58	18·38	0·46	89·32	2·51	1·04
342	10—4—34	1·45	21·17	19·01	0·63	89·80	3·33	1·09
396	3—6—34	...	19·52	15·97	0·95	81·85	5·92	1·04
			June 1933.					
266	22—2—34	1·20	20·42	17·93	0·74	88·08	4·15	1·01
313	10—4—34	1·34	22·17	19·84	0·47	89·54	2·39	1·05
367	3—6—34	...	21·03	19·00	0·53	90·36	2·80	0·99
			July 1933.					
284	11—4—34	0·95	21·32	19·22	0·39	90·24	2·05	0·88
338	4—6—36	...	17·94	15·59	0·62	87·08	3·97	0·89
			Samalkot. Co. 351.					
			September 1932.					
286	22—6—33	1·55	19·90	16·91	0·76	84·90	4·47	0·90
332	7—8—33	1·65	21·07	18·05	0·23	8 69	1·28	0·99
392	6—10—33	2·08	19·63	16·75	0·56	85·31	3·34	0·96
			October 19 2.					
253	23—6—33	0·80	15·98	12·77	1·45	79·91	11·39	0·82
299	8—8—33	1·35	16·63	13·01	1·00	78·21	7·68	0·8[illegible]
359	7—10—33	1·78	20·79	17·70	0·63	85·13	3·56	0·96
			November 1932.					
221	23—6—33	0·70	15·16	11·33	2·52	74·73	22·7	0·77
268	8—8—33	1·18	16·13	11·76	1·43	72·93	12·15	0·81
329	9—10—33	...	20·87	17·17	0·61	82·24	3·55	0·92
			December 1932.					
197	24—6—33	0·83	15·16	11·34	1·41	76·12	12·26	0·84
242	7—8—33	1·70	14·12	9·49	1·19	67·70	12·54	0·78
306	10—10—33	2·08	17·88	13·10	1·02	73·26	7·79	0·91

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Samalkot. Co. 352.					
			September 1932.					
286	22—6—33	2·78	17·4	14·64	0·68	84·16	4·65	0·84
332	7—8—33	2·75	19·37	15·39	0·45	79·43	2·92	0 95
392	6—10—33	3·15	17·01	14 07	0·31	82·71	2·20	1·05
			October 1932.					
253	23—6—33	1·13	14·16	11 97	1·86	84·55	15·53	0 83
299	8—8—33	1·78	16·63	12·96	0·96	77·94	7·41	0·83
359	7—10—33	2·03	20·79	17·70	0·25	85·13	1·41	0·92
			November 1932.					
221	23—6—33	0·95	13·95	10·69	1·93	77·34	18·10	0 83
268	8—8—33	1·60	15·13	10·83	1·25	71·58	11·54	0·76
329	9—10—33	...	18·67	15·48	0·60	82·92	3 88	0·89
			December 1932.					
197	24—6—33	1·3	12·84	8·76	1·95	68 22	22·21	0·87
242	7—8—33	1·9	14·42	11·34	0·86	77·56	7·59	0 83
306	10—10—33	2·3	16·18	12·40	0·67	76·65	5·40	1 13
			January 1933.					
273	11—10—33	1·98	15·20	11·61	1·14	76·4	9·8	0·90
334	11—12—33	2·47	19·28	16·91	0·42	87·7	2·5	0·98
			February 1933.					
309	12—12—33	2·45	17·88	15·07	0·71	84·3	0·71	1·00
353	25—1—34	2·45	21·01	19·44	Trace	92·5	...	1 05
			March 1933.					
278	13—12—33	2·77	16·88	13·66	0 92	80·9	6·7	1·08
322	26—1—34	2·90	20·01	17·83	0·33	89·1	1·8	1·01
			April 1933.					
246	14—12—33	2·00	16·37	13·69	1·12	83·6	8·2	0·99
290	27—1—34	2·17	19 51	17·49	0·33	89·6	1 9	1·08
337	15—3—34	2·32	23·12	20·67	0.14	89·4	0·69	1 03
			May 1933.					
261	29—1—34	1·65	19·25	16·94	0·33	88·0	2·0	1·00
303	13—3—34	2·00	20·65	18·76	0·27	90·8	1·4	1·02
			June 1933.					
285	13—3—34	1·32	21·35	19·16	0·20	89·73	1·07	0·87
			July 1933.					
242	14—3—34	0·97	21·92	19·64	0·17	89·58	0·85	0·96
			Maruteru. Co. 352. (Field No. A. I. A.)					
			August 1932.					
147	21—1—33	0·80	18·59	14·81	0·92	79 68	6·20	1·02
179	17—2—33	1·05	19·04	16·70	0·71	87·70	4·23	0·87
313	28—6—33	2·00	13·48	9·92	1·47	73·58	14·81	0·86
420	12—10—33	3·00	18·08	15·57	0·42	86·16	2·69	1·05
			September 1932.					
281	28—6—33	2·08	13·85	9·90	1·24	71·5	12·60	0·84
389	13—10—33	3·88	18·10	16·44	0·30	90·5	1·8	0·99
			June 1932. (*Dry*). (*Field F. 1. B.*)					
212	20—1—33	1·83	16·57	12·48	2·77	75·32	22·22	0·91
237	17—2—33	2·35	19·55	16·33	1·37	83·54	8·38	0·95

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
			June 1932. (Wet). Field K. 4 A.						
220	20...1...33	1·67	20·57	18·52	0·15	89 95	0·82	1·05	
247	19...2...33	2·08	21·35	19 66	0·27	92·08	1·38	1·02	
			January 1933.						
334	20 12...33	2·2	18·65	15·63	0·23	83·79	1 49	0·97	
355	12...1...34	1·8	19·64	17·54	0·21	89·30	1·20	1·02	
			February 1933.						
304	21...12...33	2·0	17·4	14·85	0·30	85·37	2·04	0·94	
322	8...1...34	2·4	18·04	15·56	0·31	86·26	2·00	0·97	
			March 1933.						
279	23...12...33	2·7	17·91	15·41	0 22	86·04	1·44	1·02	
296	10...1...34	2 3	19 12	16·70	0·31	87·36	1·86	1·04	
364	19...3...34	2·3	19·74	16·98	0·18	86·08	1·08	1·05	
			April 1933.						
274	11...1...34	1·6	18 71	16·01	0·29	85·59	1·80	1·04	
340	18...3...34	2·3	20·54	17·85	0·15	86·96	0·81	1·02	
			April 1933 (Swampy).						
257	6...1...34	1·2	13·85	11·11	0·71	80·21	6·39	0 92	
			May 1933.						
245	11...1...34	1·6	19·01	16·72	0·58	87·94	3·48	1·00	
309	15...3...34	1·8	22·84	20·32	0·23	88·98	1·13	1·00	
			June 1933. (Wet).						
218	9...1...34	1·5	17·43	14·63	0·74	83·97	5·08	0·96	
285	17...3...34	1·3	19 46	16·95	0·25	87·12	1·48	1·05	
			June 1933. (Dry).						
221	10—1...34	2·7	16·18	13·24	1·03	81·85	8·00	1·03	
286	16...3...34	2·1	19·81	17·54	0·36	88·50	2·04	1 06	
			Coimbatore. Co. 352.						
			March 1933.						
265	15...12...33	2·10	16·77	13·80	1·23	82·30	8·97	0 94	J. B.
345	23...2...34	2·35	20·12	18·01	0·31	89·52	1·70	1 04	J. B.
275	14...12...33	1·65	20·54	18·09	0·10	88·06	0·54	0·96	M. B.
274	13...12...33	2·10	19·24	16·65	0·39	86·54	2·32	0·88	M. B.
356	6...3...34	2·64	20·39	18·40	0·23	88·96	1·26	0·87	M. B.
			April 1933.						
245	15...12...33	1·95	19·20	16·83	0·66	87·64	3·94	0·88	
321	8...3...34	2·19	22·43	20·60	Trace.	91·85	...	0·94	
			May 1933.						
207	15...12...33	1·33	16·69	13·87	1·02	83·05	7·35	...	
292	9...3...31	2 00	20·49	17·55	0·15	85·65	0·88	...	
			June 1933.						
262	10...3...34	1·61	20·89	19·13	0·20	91·56	1·02	0·91	
			July 1933.						
234	12...3...34	1·10	18·51	15·99	0·46	86·4	2·90	0·87	
			August 1933.						
204	13...3...34	0·85	16·75	14·04	0·67	83·81	4·76	0·74	

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Co. 352. Aduthurai.					
			September 1932.					
271	14—6—33	0·69	11·8	7·5	2·1	63·6	27·70	0·77
334	16—8—33	1·50	17·3	14·7	0·4	84·7	2·73	0 88
			October 1932.					
243	15—6—33	0·62	15·3	11·8	1·00	77·4	8·47	0·80
305	16—8—33	0·58	19·6	17·4	0·12	89·0	0·70	0·91
			November 1932.					
212	16—6—33	0·44	14·9	11·3	0·98	75·9		0·79
274	17—8—33	0 34	18·1	15·6	0·15	86 1		0·88
329	12—10—33	0·48	18·9	16·9	0·08	89·5		0·90
			December 1932.					
244	17—8—33	0·62	19·5	17·2	...	88·3		0·90
299	12—10—33	0·62	19·0	16·9	0·09	88·8		0·89
360	11—12—33	0·61	16·8	12·1	1·95	71·9		0 83
			January 1933.					
268	12—10—33	1·12	18·9	16·2	0·24	85·8		0·84
330	11—12—33	0·81	19·4	16·5	0·12	84 9		0 97
			February 1933.					
237	13—10—33	1·62	19·1	16·6	0·31	86 9		0·87
299	12—12—33	1·36	21·1	19·4	0·08	91·6		0·95
			March 1933.					
209	13—10—33	1·43	16·8	14·4	0·41	85·5		0 84
269	12—12—33	1·13	20·3	18·0	0·13	88·6		0·98
344	...	No material for analysis.						
			April 1933.					
239	13—12—33	2·21	20·3	17·8	0·21	87·84		0·93
311	25—2—34	1·81	19·4	17 2	0·18	88·9		1·00
333	17—3—34	2·37	18·2	16·3	0 16	89·4		1·04
			May 1933.					
210	13—12—33	1·87	18 6	15·6	0·58	84·2		0·93
283	25—2—34	1·36	20·4	18·3	0·20	89·9		1·03
305	17—3—34	1·86	19·7	17·6	0 15	89·5		1·11
			June 1933.					
252	26—2—34	1·53	19·6	17·4	0·18	88·8	1·00	1 00
274	18—3—34	1·49	20·1	17·9	0·11	89·2	0·61	1 03
			July 1933.					
222	26—2—34	1·18	20·2	18·1	0·27	89·6	1·50	0·97
245	19—3—34	0·88	19·3	16·9	0·22	88·0	1·31	0·97
			Co. 351. Palur.					
			September 1932.					
242	15...5..33	0·97	12·3	8·6	2·5	70·0		0·85
277	19...6...33	1·65	14·2	10·7	2·4	75·4		0·91
331	12...8...33	2·15	16·4	13·4	1·1	81·7		0·96
			October 1932.					
246	20...6...33	0·80	11·6	7·6	2·8	64·6		0·89
300	13...8...33	1·25	15·3	11·7	2·2	76·5		0·96

TABLE I (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
November 1932.								
215	21—6—33	0·79	11·9	7·2	3.3	60·5		0·89
269	13—8—33	1·59	17·0	13·8	1·5	81·3		1·00
325	9—10—33	1·55	17·5	14·8	1·2	84·9		0·94
December 1932.								
242	14—8—33	1·25	16·4	13·4	1·4	81·4		0·95
299	10—10—33	1·13	16·8	13·7	0·9	81·9		0·96
Co. 352. Palur.								
September 1932.								
242	15—5—33	1·37	11·2	7·7	3·1	68·5		0·93
277	19—6—33	2·00	12·6	9·0	2·3	71·7		0·95
331	12—8—33	2·05	14·7	12·0	1·3	81·7		1·00
October 1932.								
246	20—6—33	1·20	10·8	6·8	3·1	63·0		0·93
300	13—8—33	1·93	14·8	11·4	1·6	77·2		0·95
November 1932.								
215	21—6—33	0·91	11·9	7·5	2·9	62·8		0·93
269	13—8—33	1·20	15·8	12·7	1·6	80·5		0·92
329	9—10—33	1·60	16·2	13·5	0·9	83·7		0·92
December 1932.								
242	14—8—33	1·20	14·5	11·0	1·7	75·6		1·00
298	9—10—33	1·18	17·0	14·4	0·5	84·8		0·98
January 1933.								
210	14—8—33	1·24	16·27	13·2	1·1	81·1		0·92
266	10—10—33	1·60	17·36	15·1	0·5	85·7		0·99
365	17—1—34	1·65	15·41	13·0	0·5	84·3		0·95
February 1933.								
236	10—10—33	1·50	16·51	13·9	1·1	84·2	7·98	0·84
337	18—1—34	1·73	17·6	16·0	0·4	90·7	2·25	1·00
363	14—2—34	1·60	17·1	15·3	0·4	89·5	2·65	1·06
March 1933.								
208	10—10—33	1·48	14·0	10·4	1·7	74·6	16·57	0·81
306	18—1—34	1·48	16·8	14·7	0·8	87·5	5·34	0·97
336	15—2—34	1·33	16·2	14·2	0·8	87·7	5·50	1·03
April 1933.								
277	19—1—34	1·45	15·1	12·5	1·6	82·9	12·55	0·94
304	15—2—34	2·15	15·2	12·7	1·2	83·4	9·51	0·97
333	12—3—34	1·68	16·7	14·2	1·1	85·2	8·02	0·98
May 1933.								
247	19—1—34	1·73	14·3	11·6	2·4	81·3	20·45	0·96
274	16—2—34	1·53	14·8	11·8	1·7	79·8	14·24	1·06
303	12—3—34	1·05	17·7	15·3	0·9	86·5	5·86	0·98
June 1933.								
215	19—1—34	1·15	12·7	9·4	2·4	74·4	25·2	0·90
243	16—2—34	0·78	16·4	14·0	1·0	85·3	6·9	1·01
274	13—3—34	1·30	17·6	15·0	1·0	84·8	6·8	1·02
343	26—5—34	1·05	15·3	12·2	1·35	80·2	11·0	0·92
July 1933.								
244	13—3—34	0·75	19·3	17·1	0·4	88·6	2·5	1·01
312	26—5—34	0·98	15·0	12·7	1·0	84·7	8·1	0·87

Table II.

Comparative studies of crops of approximately equal ages irrespective of the time of planting.

Co. 352.

Station.	Date of planting.	Date of analysis.	Weight of a cane in lbs.	Brix.	Coefficient of purity.	Top/Bottom ratio.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		(210–220 days old).				
Anakapalle	2...9...32	31—3—33	1·9	15·7	79·7	0·80
	1—10—32	30—4—33	1·6	15 0	72·2	0·78
	1—12—32	8—7—33	1·1	12 8	71·7	0 95
Palur	18—11—32	21—6—43	0·9	11·9	62·8	0·93
	17—1—33	14—8—33	1·2	16·3	81·1	0·92
	16—3—33	10—10—33	1·5	14·0	74·6	0·81
	17—6—33	19—1—34	1·2	12·7	74·4	0·90
Aduturai	16—11—32	16—6—33	0·4	14·9	75·9	0·79
	17—3...33	13—10—33	1·4	16·8	85·5	0·84
	17—5—33	13—12—33	1·9	18 6	84·2	0·73
	18—7—33	26—2—34	1·2	20·2	89·6	0·97
Coimbatore	22—5—33	15—12—33	1·3	16·7	83·1	0·87
	22—8—33	13—3—34	0·9	16 8	83·8	0·74
Samalkot	14—11—32	23—6—33	1·0	14·0	77·3	0·83
		(235–245 days old).				
Anakapalle	2—9—32	30–4–33	2·30	16·1	79·43	0·79
	5—11—32	8–7–33	1·20	13·2	73·30	0·80
Palur	15—9—32	15–5–33	1·37	11·2	68·5	0·93
	17—10—32	20–6–33	0·80	11·6	64·6	0·89
	15—12—32	14–8–33	1·20	14·5	75·6	1·00
	16—2—33	10–10–33	1·50	16·5	84·2	0 84
	17—5—33	19–1–34	1 73	14·3	81·3	0·96
	17—6—33	16–2–34	0 78	16·4	85·3	1·01
	17—7—33	13–3–34	0·78	19 3	88·6	1·01
Aduturai	15—10—32	15–6–33	0·60	15·3	77·4	0 80
	16—12—32	17–8–33	0·60	19 5	88 3	0·90
	17—2—33	13–10–33	1·60	19·1	86·9	0·87
	17—4—33	13–12–33	2·20	20·3	87·8	0·93
	18—7—33	19–3–34	0·90	19·3	88·0	0·97
Coimbatore	14—4—33	15–12–33	2·00	19 2	87·6	0·88
	22–7–33	12–3–33	1·10	18·5	86·4	0·87
Samalkot	8–12–32	7–8–33	1·90	14·4	77·6	0·83
	12–4–33	12–12–33	2·00	16·4	83·6	0·99
	16–7–33	14–3–34	1·00	21·9	89·6	0·96
Maruteru	10–5–33	11–1–34	1·60	19·0	87·9	1·00
		(250–265 days old).				
Anakapalle	2–9–32	13–5–33	2·40	15·7	85·6	0·84
	1–5–33	22–1–34	1·30	19·0	88·8	1·02
Aduturai	18–6–33	26–2–34	1·50	19·6	88·8	1·06
Coimbatore	15–3–33	5–12–33	1·40	17·0	82·3	0·83
	22–6–33	10–3–34	1·60	20 9	91·6	0 91
Samalkot	12–10–32	23–6–33	1·10	14·2	84·6	0·83
	5–33	29–1–34	1·70	19·3	88·0	1 00
		(266–275 days old).				
Anakapalle	1–3–33	29–11–33	1·50	15·80	86·7	0·97
	1–4–33	28–12–33	1·30	14·70	84·7	1·01

TABLE II (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6).	(7)
Palur	15—9—32	19—6—33	2·00	12·56	71·7	0·95
	18—11—32	13—8—33	1·20	15·80	80·5	0·92
	17—3—33	10—10—33	1·60	17·60	85·7	0·99
	17—5—33	16—2—34	1·53	14·80	79·8	1·06
	17—6—33	13—3—84	1·30	17·60	84·8	1·02
Aduturai	16—9—32	14—6—33	0·70	11·80	63·6	0·77
	17—1—33	12—10—33	1·10	18·90	85·8	0·84
	17—3—33	12—12—33	1·10	20·3	88·6	0·98
	18—6—33	18—3—34	1·49	20·1	89·2	1·03
Coimbatore	15—3—33	14—12—33	1·70	19·7	88·3	0·87
Samalkot	14—11—33	8—8—33	1·60	15·1	71·6	0·76
	11—1—33	11—10—33	1·98	15·2	76·4	0·91
	10—3—33	13—12—33	2·80	16·9	80·9	1·08
Maruteru	12—4—33	11—1—34	1·60	18·7	85·6	1·04
			(276–285 days old).			
Anakapalle	1—10—32	8—7—83	1·70	12·80	78·3	0·86
	1—7—33	11—4—34	0·95	21·30	90·2	0·88
Palur	15—9—32	19—6—33	2·00	12·60	71·7	0·95
	17—4—33	19—1—34	1·50	15·10	82·9	0·94
Aduturai	17—5—33	25—2—34	1·40	20·40	89·9	1·03
Samalkot	9—9—32	22—6—33	2·78	17·40	84·2	0·84
	10—3—33	13—12—33	2·77	16·90	80·9	1·08
	18—6—33	13—3—34	1·32	21·40	89·7	0·87
Maruteru	20—9—32	28—6—33	2·08	13·85	71·5	0·84
	20—3—33	23—12—33	2·70	17·90	86·0	1·02
(wet)	5—6—33	17—3—34	1·30	19·50	87·1	1·05
(dry)	3—6—33	16—3—34	2·10	19·8	88·6	1·06
			(286–296 days old).			
Anakapalle	1 - 4 - 33	21 - 1 - 34	1·02	18·0	86·1	1·05
	1 - 5 - 33	21 - 2 - 34	1·47	20·6	89·3	1·04
Coimbatore	22 - 5 - 34	9 - 3 - 34	2·00	25·5	85·7	0·93
Samalkot	12 - 4 - 33	27 - 1 - 34	2·17	19·51	89·60	1·08
Maruteru	20 - 3 - 33	10 - 1 - 34	2·30	19·12	87·40	1·04
			(297–307 days old).			
Anakapalle	1 - 12 - 32	4 - 10 - 33	1·90	14·4	77·7	0·89
	2 - 2 - 33	28 - 11 - 33	1·50	16·5	91·9	1·02
	1 - 3 - 33	27 - 12 - 33	1·38	17·6	87·0	1·03
	1 - 4 - 33	21 - 1 - 34	1·02	18·0	86·1	1·05
	1 - 5 - 33	21 - 2 - 34	1·47	20·6	89·3	1·04
Samalkot	13 - 10 - 32	8 - 8 - 33	1·78	16·60	77·90	0·83
	8 - 12 - 32	10 - 10 - 33	2·30	16·20	76·70	1·13
	6 - 2 - 33	12 - 12 - 33	2·50	17·90	84·30	1·00
	12 - 4 - 33	27 - 1 - 34	2·50	19·20	84·00	1·08
	- 5 - 33	13 - 3 - 34	2·00	20·70	90·80	1·02
Aduturai	15 - 10 - 32	10 - 8 - 33	0·60	19·60	89·00	0·91
	16 - 12 - 33	12 - 10 - 33	0·60	19·00	88·80	0·89
	17 - 2 - 33	12 - 12 - 33	1·00	21·10	91·60	0·95
	17 - 5 - 33	17 - 3 - 34	1·90	19·70	89·50	1·11
Palur	17 - 10 - 32	13 - 8 - 33	1·90	14·80	77·2	0·95
	15 - 12 - 32	9 - 10 - 33	1·20	17·00	84·8	0·98
	16 - 3 - 33	13 - 1 - 34	1·50	16·80	87·5	0·97
	17 - 4 - 33	15 - 2 - 34	2·20	15·20	83·4	0·97
	17 - 5 - 33	12 - 3 - 34	1·05	17·70	86·5	0·98

TABLE II (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Maruteru	21—2—33	21—12—33	2·00	17·40	90·80	0·94
	20—3—33	10—1—34	2·30	19·10	85·37	1·04
	10—5—33	15—3—34	1·80	22·80	87·36	1·00
		(308–318 days old).				
Anakapalle	2—9—32	8—7—33	3·10	13·50	80·70	0·96
	1—6—33	10—4—34	1·30	22·2	89·50	1·05
Aduturai	17—4—33	25—2—34	1·80	19·40	88·92	1·00
Samalkot	6—2—33	12—12—33	2·50	17·90	84·30	1·00
Maruteru	10—5—33	15—3—34	1·80	22·80	89·00	1·00
	19—8—32	28—6—33	2·00	13·50	73·60	0·86
		(319–330 days old).				
Anakapalle	3—1—33	27—11—33	1·10	16·36	89·70	0·99
	2—2—33	27—12—33	1·40	17·24	87·60	1·05
	1—3—33	21—1—34	1·60	18·94	91·60	1·04
	1—4—33	21—2—34	1·70	20·58	90·00	1·09
Aduturai	16—11—32	12—10—33	0·50	18·94	89·50	0·90
	17—1—33	11—12—33	0·80	19·41	84·90	0·97
Samalkot	14—11—32	9—10—33	...	18·70	82·90	0·89
	10—3—33	26—1—34	2·90	20·00	89·10	1·01
Maruteru	21—1—33	8—1—34	2·40	18·00	86·30	0·97
Coimbatore	14—4—33	8—3—34	2·19	22·40	91·85	0·94
Palur	18—11—32	9—10—33	1·60	16·20	83·70	0·92
		(331–340 days old).				
Anakapalle	5—11—32	4—10—33	2·00	14·10	71·30	0·90
Samalkot	9—9—32	7—8—33	2·80	19·40	79·40	0·95
	11—1—33	11—12—33	2·50	19·30	87·70	0·98
	12—4—33	15—3—34	2·30	23·20	...	1·03
Maruteru	22—1—33	20—12—33	2·20	18·70	83·80	0·97
	12—4—33	18—3—34	2·30	20·50	87·00	1·02
Aduturai	16—9—32	16—8—33	1·50	17·30	84·70	0·88
	17—4—33	17—3—34	2·40	18·20	89·40	1·04
Palur	15-9-32	12-8-33	2·00	14·70	81·70	1·00
	16-2-33	18-1-34	1·70	17·60	90·70	1·00
	16-3-33	15-2-34	1·30	16·20	87·70	1·03
		(341–350 days old).				
Anakapalle	1-5-33	10-4-34	1·50	21·17	89·80	1·09
Coimbatore	15-3-33	23-2-34	2·40	20·12	89·52	1·04
		(351–360 days old).				
Anakapalle	3-1-33	26-12-33	1·30	17·60	89·7	1·03
	2-2-33	20-1-34	1·60	19·80	91·3	1·05
	1-3-33	20-2-34	1·40	19·60	87·48	1·05
Samalkot	13-10-32	7-10-33	2·00	20·80	85·10	0·92
	6-2-33	25-1-34	2·50	21·00	97·20	1·05
Maruteru	22-1-33	12-1-34	1·80	19·60	89·30	1·02
Coimbatore	15-3-33	6-3-34	2·60	20·40	89·00	0·97
Aduturai	16-12-32	11-12-33	0·61	16·80	71·90	0·83
		(361–370 days old).				
Anakapalle	1-10-32	4-10-33	3·23	13·50	68·4	0·93
	1-12-32	27-11-33	2·20	16·50	93·4	1·04
Maruteru	20-3-33	19-3-34	2·30	19·74	86·08	1·05

TABLE II (*Continued*).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Palur	17 - 1 - 33	17 - 1 - 34	1·65	15·40	84·30	0·95
	6 - 2 - 33	14 - 2 - 34	1·60	17·10	89·50	1·06
		(371–380 days old).				
Anakapalle	1—4—33	9—4—34	1·54	21·00	90·20	1·05
		(381–390 days old).				
Anakapalle	5 - 11 - 32	28 - 11 - 33	2·00	15·56	89·90	1·02
	1 - 12 - 32	26 - 12 - 33	2·20	18·80	90·07	0·98
	3 - 1 - 33	20 - 1 - 34	1·35	19·30	91·40	1·02
	2 - 2 - 33	20 - 2 - 34	1·52	20 55	87·30	1·07
Maruteru	20 - 9 - 32	13 - 10 - 33	3·90	18·20	90·50	0·99
		(391–400 days old).				
Anakapalle	2 - 9 - 32	4 - 10 - 33	3·55	13·20	70·20	1·14
	1 - 3 - 33	9 - 4 - 34	1·53	22·20	90·10	1·08
Samalkot	9 - 9 - 32	6 - 10 - 33	3·15	17·00	82·70	1 05
Maruteru	19 - 8 - 32	12 - 10 - 33	3·00	18·08	86·16	1·05
		(less than 200 days old).				
Anakapalle	2 - 9 - 32	10 . 2 - 33	1·02	13 40	64·90	0·79
	1 - 10 - 32	31 - 3 - 33	1·05	12·30	63·00	0·71
Samalkot	8 - 12 - 32	24 - 6 - 33	1·30	12·80	68·20	0·87

Research Note

A new and important weed host of the cotton stem weevil ***(Pempheres affinis F.)***

In the course of an intensive field study of the alternative food plants of the weevil, various species belonging to Malvaceae, Tiliaceae and allied orders were collected and examined. A few among them such as *hibiscus vitifoleus sida spinosus corchorus olitorus* were noted to harbour a small but varying proportion of weevil stages. But the highest infestation was observed in a hitherto unrecorded weed host *malvastrum coromandelianum* (Garcke). This weed is widely distributed and abundant on all wastelands, sometimes also associated with cultivated crops, in borders of fields, along road sides, tank bunds, sides of water channels, fences and other neglected places.

The younger plants were generally free and not attacked while the majority of the medium sized and large ones were infested. The mode of attack of the weevil is approximately similar to that in cotton. The nature of the injury and the character and course of the tunnels are also roughly similar. In a small number of cases galls are also produced. As many as three galls have been noted to be developed in the same plant. A small percentage of mortality is also seen to be caused among such plants. A maximum of nine attacks with six live grubs of varying stages has been noted in a single plant. The following table presents the data obtained in regard to the weevil population in the different lots of this plant material.

Total No. of plants examined.	% of attacked plants.	Total number of live stages.				Emergence apertures.	Mere infestations	No. of infestations per 100 plants.	No. of live stages per 100 plants.
		Larva.	Prepupa.	Pupa.	Adult.				
558	42	116	9	2	7	14	154	54	24

In view of its abundance and intense susceptibility to weevil infestation (with a maximum of 65%), *Malvastrum coromandelianum* appears to be in certain seasons, the foremost weed host of the cotton stem weevil capable of maintaining fairly large populations in the absence of cotton. The importance of such offseasonal hosts is all the greater because the pest populations even in country cottons during this part of the season are seen to be rather insignificant. Further studies in this line are in progress.

I am thankful to fieldman Royappan for the collection of host plants.

Cotton breeding Station, 3—10—'36. P. N. Krishna Iyer, Parasitologist.

Agricultural Notes.

1. In the coastal tracts of Tekkali taluk, Vizagpatam district, where the villagers are able to get fuel from various topes, and where the soils are in bad need of manuring, ryots do not at all waste cattle dung by using it as fuel, but add every bit of it to their fields after careful conservation. Soils are frequently spread over the floor of the cattle sheds for catching cattle urine; and the urinary earth, dung and litter are carefully conserved in pits with great care. It is refreshing to note in this tract where Departmental propaganda was not undertaken till recently the practices in the conservation of cattle manure have been developed to a high degree of perfection. Possibly the availability of fuel, and the hungry nature of the soils requiring manuring are responsible for the adoption of these commendable practices that are proving uphill tasks in other areas.

2. Erythrina (*Erythrina indica*) is the popular hedge plant round each holding as it supplies not only the necessary standards to each cultivator, but also timber for boat building. It is claimed that unlike other trees Erythrina does not affect the neighbouring crops and can conveniently be planted wherever props for fences are required. In places where white-ant attack is so serious as not to allow any posts in tact even for few months, the introduction of Erythrina standards by raising nurseries in the beginning, if necessary, may be encouraged. Its seeds can be got in the tract for mere asking.

3. With the annual depredation of Red Hairy Caterpillar (*Amsacta albistriga*) the villagers in the tract had emigrated largely to Burma. The members left at home find it difficult to cultivate the fields far away. Only the fertile plots adjoining the villages are cropped. The others are being gradually planted with cashewnut, which is not only proving to be a profitable hardy fruit tree for the poor soils, but also is free from the caterpillar pest. This practice can be copied by farmers of other tracts where similar conditions prevail.

4. The introduction of cashew nut did not prove to be an unmixed blessing as the poor patches of fields planted with them affect the neighbouring plots by the spreading roots of cashew. To overcome this, ryots dig deep trenches along sides of fields as is done on Government Farms for experimental plots, and these trenches serve also to trap *Amsacta* caterpillars during the period of their ravages.

5. It is our common experience that filling up gaps in live hedges with any live plant material is difficult, but in the above tract *Pandanus* is freely made use of. The stems when closely planted in the gap immediately serve as barrier and take root quickly. The live fences round each holding support vegetable creepers of bittergourd and *Agakara* (a variety of bitter gourd), by the sale of which a fair income is derived. These creepers are almost of perennial nature—bitter gourd continuing from year to year with self sown seed, and *Agakara* with underground stems.

6. It was found in parts of Tekkali taluk that the Red Hairy Caterpillar (*Amsacta albistriga*) establishes itself as a sort of indigenous pest on some of the mountain sides with *Canthium paraviflorum* (Tel :— Balusu) shrubs as host, but its presence is not felt in the neighbouring cultivated dry areas since these areas support only ragi crop, the planting of which commences after the hairy caterpillars are full grown and about to pupate. Thus agriculture and pest in these areas have mutual adjustment without any positive interference with one another and is worth copying in other places with similar conditions.

V. Tirumal Rao,
Entomology Assistant, Samalkota

ABSTRACTS

The Indian Coffee Cess Committee. Under the Indian Coffee Cess Act No. XIV of 1935 has been created a fund derived from the levy of a customs duty of 8 annas per cwt. on all coffee produced in India and taken by sea or by land to any place beyond the limits of British India or Burma. During the year the cess receipts which amounted to over a lakh were actually far more than the estimated amount which was only about Rs. 85,000 per annum. The coffee cess committee is so constituted that the three main interests. the grower, the trader and agricultural expert are directly represented in it. It is composed of a representative from each of the local departments of agriculture of Mysore, Travancore and Cochin, a representative for each of the curing, manufacturing and shipping interests, and eleven representatives for coffee growers, of whom Mysore being the premier coffee growing area, has been given the right to send three. In addition, the Imperial Council of Agricultural Research sends a representative to the Committee.

The activities of the committee have been directed along many lines ; a coffee marketing survey to collect data relating to the transport, sale, consumption etc. of coffee, the establishment in co-operation with the High Commissioner of an Indian coffee market Expansion Board in London, with the main object of explaining the possibilities of expanding the market for Indian coffee in the United Kingdom and on the Continent, and the launching of a 'Drink Indian coffee' campaign in India itself, are the outstanding achievements of the committee. The last mentioned campaign has included many methods of coffee publicity propaganda, like the employment of attractively dressed waiters to serve coffee in coffee houses, the display of posters and menu cards, the pressing into service of cinemas and newspapers; and for the future is programmed even a demonstration truck.

The committee has also paid attention to the question of adulteration of coffee and have besides made a strong representation to the Government that preference granted to Indian coffee in the United Kingdom be increased from 1 d. to 3 d. per lb.

The committee have opened a Central Information Bureau at Bombay and serious attempts are being made to collect all available data and statistics on the subject.

(Summarised from a leaflet No. 1, October 1936 of the Indian coffee cess committee).

M. R. B.

The absorption of nutrients by two varieties of wheat grown on the black and gray soils of Alberta. By E. K. Woodford and A. G. McCalla. Chemical analyses carried out at five stages of development of Reward and Red Bobs wheat grown on the black and the gray soils of Alberta showed that differences in soil and variety significantly influenced the composition of the plants.

The weights of dry matter and all nutrients studied were higher for the black soil plants.

On the basis of percentage of dry matter, all nutrients, except phosphorus, were higher in the black-soil plants. Reward was higher than Red Bobs in nitrogen when grown on the black soil; and in ash, phosphorus and potassium when grown on the gray soil.

The grain of gray-soil plants was higher in all ash constituents but lower in nitrogen. Varietal differences were more marked in the grain and straw of the mature plants, Reward grain grown on both soils being higher in nitrogen, ash, phosphorus and magnesium.

The total weights percentages, rates of absorption and ion ratios all indicated that nitrogen and sulphur were limiting the growth of wheat on the gray soil. It is suggested that the proportionately higher absorption of phosphorus from the soil was in compensation for the low availabilty of nitrogen and sulphur.

The differences in original quality of the wheats grown on the two soils can be largely accounted for by the differences in protein content, and therefore nitrogen supply. Phosphorus absorption, nitrogen, phosphorus and sulphur balance, and the relation of ash to protein, are possibly important in determining the keeping properties of the flour. Author's abstract.

[Possibly such differences in the composition are responsible for the smaller damage done by the insects to the trees on the black soils. —Ed.]

Gleanings.

Potatoes: Acceleration of Sprouting. Farmers who grow potatoes under irrigation for the early market during the winter often have difficulty in securing sprouted " seed " for planting or inducing their own " seed " to sprout sufficiently early. Some growers of main crop potatoes, too, who prefer to use " seed " grown under irrigation in winter have a similar difficulty. A solution of this problem has been tested at the Agricultural Experimental Station, Salisbury, during experiments on fumigating potatoes with carbon bisulphide to kill " tuber moth ".

The tubers should be placed in an air tight room or receptacle, such as a corrugated iron tank. A pit in the ground covered with a tarpaulin has not proved satisfactory, probably owing to the vapour being absorbed by the earth. On the otherhand a tarpaulin covering to an iron tank would be satisfactory, since the vapour is 2·6 times heavier than air, and so will not tend to rise and find its way through the tarpaulin.

Carbon bisulphide should be placed in shallow trays or dishes on the top of the " seed " tubers and the room or receptacle closed. The liquid evaporates readily on a warm day and the vapour being heavier than air, flows over the sides of the trays and fills the receptacle. It is advisable to commence the treatment on a warm morning, so that the liquid will evaporate rapidly. The tubers should undergo the treatment for 24 to 48 hours, and two tablespoonfuls of the carbon bisulphide are required to each cubic yard, or 27 cubic feet of volume of the receptacle, irrespective of whether the latter is filled with tubers or only partly so. Within ten days about 75 % of the " seed " would be commencing to sprout. When sprouting has commenced, it may be further accelerated by placing the tubers in a gently warmed tobacco barn or in a warm room, in which the air is kept reasonably moist. It is useful to know that carbon bisulphide is sold by the pound weight. One pound is equivalent to approximately 13 ounces (liquid measure) or 26 tablespoonfuls. *Rhodesia Agricultural Journal* Vol. 33 pp. 378.

Review.

The Bulletin of the Imperial Institute, London, has now been enlarged to give a more complete reflection of the various activities of the Institute. The Bulletin contains interesting results of laboratory investigations as well as useful articles and notes on plant and animal products, and on ores and minerals. The last two issues contain, among many others, notes on drying of hides and skins; improvement in the quality of ghee; cultivation of Tung oil tree; Cacao fermentation; weed-killers; cultivation of lemon-grass and distillation of its oil; colouration of glass by mineral compounds; mineral resources of Johore, British Somaliland and Abyssinia; Empire nickel developments; the Dead Sea potash industry; and magnesium compounds from sea water. The Institute is to be congratulated on the reduction of the price of the Bulletin, which it has been able to make in spite of the extended scope of its contents.

J. S. P.

Crop & Trade Reports.

Receipt of raw cotton at Press and Spinning Mills.

Total cotton pressed and unpressed.

	Bales of 400 lbs. against an estimate of 540,700 bales for 1935-36.	Figures for corresponding period in previous years.
1-2-36 to 16-10-36	557,708	411,591
,, 23-10-36	563,572	415,926
,, 30-10-26	570,480	420,325
,, 6-11-36	574,397	423,826
,, 13-11-36	582,532	428,217

	Cotton bales received at mills.	Export by sea.	Import by sea.
1-2-36 to 16-10-36	335,774	220,362	94,628
,, 23-10-36	341,555	223,869	94,743
,, 30-10-36	350,000	230,043	94,949
,, 6-11-36	354,780	232,503	95,451
,, 13-11-36	361,259	236,456	95,511

Cotton—Intermediate Report 1936--37. In parts of the Central districts and the South, the sowings of cotton are still in progress. The area under the crop is expected to be normal. The condition of the young crop is generally fair.

2. In the Deccan, the sowings of *hingari* or late cotton have concluded and are expected to be above normal in the districts of Bellary and Anantapur on account of the failure of rains in the mungari season and the consequent restricted sowings. The yield from mungari or early cotton is expected to be generally below normal. In parts of Guntur, the Cocanadas, cotton has been affected by the cyclone on the 28th October 1936.

3. The local cotton trade is not generally active at this time of the year. The wholesale price of cotton lint per imperial maund of 82-2/7 lb. as reported. from important markets towards the close of October 1936 was Rs. 19-9-0 for Cocanada, Rs. 25-11-9 for Red Northerns, Rs. 18-11-0 for Westerns. Rs. 24-14-0 for Cambodia, Rs. 24-5-0 for Coimbatore Karunganni, Rs. 23-2-0 for Tinnevelly Karunganni, Rs. 22-4-0 for Tinnevellies and Rs 21-4-0 for Nadam cotton As compared with the prices in the previous month, the prices of Red Northerns reveal a rise of about 9 per cent. while those of the other varieties are practically stationary.

Paddy—Intermediate Report 1936—37. The harvest of first crop paddy has either concluded or is concluding in parts of the Central districts, the South and the West Coast. The yield is reported to be generally normal. The crop is reported to have been affected to some extent by drought in parts of Kistna, Anantapur, Chingleput and South Arcot and by the attack of insects in parts of East Godavari, West Godavari, Salem and Malabar. The severe cyclone of the 28th October has lodged the crop in parts of Kistna and Guntur. The condition of the crop is reported to be generally satisfactory in the other districts.

2. The wholesale price of paddy per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of October was Rs. 2 - 14 - 0 in Vizianagaram and Cuddapah, Rs. 2 - 12 - 0 in Madura, Rs. 2 - 11 - 0 in Salem, Rs. 2 - 10 - 0 in Nellore, Rs. 2 - 6 - 0 in Vellore and Erode, Rs. 2 - 5 - 0 in Nandyal, Rs. 2 - 4 - 0 in Guntur, Rs. 1 - 15 - 0 in Cocanada and Tinnevelly, Rs. 1 - 13 - 0 in Kumbakonam, Rs. 1 - 12 - 0 in Negapatam and ranged from Rs. 2 - 2 - 0 to Rs. 2 - 3 - 0 in the other markets. As compared with the prices reported for September 1936, the prices are stationary in Vizianagaram, Masulipatam, Guntur, Nandyal, Vellore, Salem, Trichinopoly and Kumbakonam while they reveal a rise of 3 per cent. in Madura and a fall of 2 to 5 per cent. in the other markets.

Sugarcane—Intermediate report. 1936-37. The cyclone of the 28th October 1936 lodged the sugarcane crop in parts of the districts of Kistna and Guntur. In the North Arcot District, the crop suffered to some extent from drought. The condition of the crop is satisfactory in the other districts and the yield is expected to be normal if the season continues to be favourable.

2. The wholesale price of jaggery per imperial maund of 82-2/7 lb. as reported from important markets towards the close of October 1936 was Rs. 6-1-0 in Adoni, Rs. 5-12-0 in Madura, Rs. 5-6-0 in Nandyal, Rs. 5 in Mangalore, Rs. 4-15-0 in Bezwada, Rs. 4-12-0 in Masulipatam, Guntur and Tuticorin, Rs. 4-10-0 in Kumbakonam, Rs. 4-7-0 in Calicut, Rs. 4-5-0 in Rajahmundry, Rs. 4-4-0 in Ellore, Rs. 4-1-0 in Coimbatore, Rs. 3-13-0 in Cocanada and Salem, Rs. 3-11-0 in Bellary and Cuddapah, Rs 3-2-0 in Vellore Rs. 3 in Vizagapatam, Rs. 2-15-0 in Trichinopoly and Rs. 2-8-0 in Tinnevelly. As compared with the prices of the previous month, the prices reveal a rise of 12 per cent in Trichinopoly, 5 per cent in Mangalore, 4 per cent in Vizagapatam, 3 per cent in Masulipatam and Salem and 2 per cent in Cocanada and a fall of 14 per cent in Vellore, 11 per cent in Bellary, 4 per cent in Madura, 3 per cent in Nandyal and 1 per cent in Ellore whilst they remained stationary in the other centres.

Groundnut—Intermediate Report. 1936. The condition of the winter crop of groundnut is satisfactory in the Circars. Coimbatore, Ramnad, Tinnevelly and the West Coast. Elsewhere the crop has been affected by drought to some extent.

2. The wholesale price of groundnut (shelled) per imperial maund of 82-2/7 lbs. as reported from important markets towards the close of October 1936 was Rs. 6—4—0 in Coconada, Rs. 5—15—0 in Cuddalore, Rs. 5—9—0 in Guntur and Negapatam, Rs. 5—7—0 in Vizagapatam, Rs. 5—4—0 in Vizianagaram, Rs. 4—15—0 in Vellore, Rs. 4—14—0 in Cuddapah and Salem, Rs. 4—12—0 in Coimbatore, Rs. 4—9—0 in Nandyal, Rs. 4—8—0 in Adoni, Rs 4—6—0 in Madura, Rs. 4—4—0 in Ellore and Rs. 4—3—0 in Tinnevelly. As compared with the prices of the previous month, the prices are stationary in Negapatam and Tinnevelly, while they reveal a fall of 21 per cent in Nandyal, 18 per cent in Vizianagaram and Madura, 13 per cent in Vellore, 10 per cent in Guntur, 9 per cent in Adoni, 7 per cent in Vizagapatam, 5 per cent in Cuddapah, 4 per cent in Ellore and Coimbatore and 1 per cent in Cuddalore and a rise of 4 per cent in Cocanada and 3 per cent in Salem.

College News and Notes.

M. R. Ry. Rao Bahadur S. Sundararama Iyer, M. A., I. A. S. (One of our ex-Vice Presidents) retired from service on the 7th November. A tea was arranged in the Officers' Club in honour of his retirement.

Mr. K. M. Thomas one of our members who had been to England on study leave returned early this month and has been appointed to officiate as the Government Mycologist. We take this opportunity to congratulate him on his promotion.

The Director of Agriculture, Madras paid a visit early this month in connection with the supply of Siruvani water to the Estate.

Student's corner. Under the auspices of the Agricultural College Students' club a paper on "How to approach the Indian ryot with the message of modern Agriculture" was read by J. Gopal Rao of the final year with Dr. J. A. Muliyil, M. A., Ph. D. in the chair.

Football. The second match of the Abraham Memorial Football Tournament, was played between the college XI and the Government College High School in the Stadium grounds. The match ended in a defeat to our College by 3 goals to nil.

Hockey. The College was defeated by 5 goals to 1 by the Madras Forest College in a friendly match played on their grounds. In connection with the Inter-Collegiate Tournament, a match was played with the local Government Arts College when our team scored 11 goals against nil. The College also won in a match played against the Recruit School. The first match of the Y. M. C. A. Tourney played against the Papanaickanpalayam ended in a victory to the College by 2 goals to nil. The second match of the Y. M. C. A. Tourney played against the Stane's High School in the Forest College grounds had to be abandoned after the first half, owing to the intervention of rain. The Inter-Collegiate finals were played against the Alwaye Government College; our College won by 2 goals to nil.

Cricket. In a friendly match played against the Govt. College High School, our B. Team won by 17 runs. The High School team was out for 85 runs, the top scorer being Padmanaban (23 runs). The College players were able to pile up 102 runs. A match was played between the College team and Sivaganga Rajah's team. The visitors were out for 69 runs. Our team was skittled out for a paltry 46. Mr. Dinker Rao was in his full form and gathered 15 runs in a very short time, but unfortunately was run out. Mr. A V. Krishnaswami and Parthasarathy took 4 and 5 wickets respectively.

The students of the 3rd year after an interesting and happy tour returned on the morning of the 16th October.

Weather Review (OCTOBER 1936.)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	14·7	+6·7	80·7
	Berhampore*	6·7	-4·0	57·1
	Calingapatam	7·8	-0·2	43·3
	Vizagapatam	12·3	+5·2	35·8
	Anakapalli*	7·8	+0·8	36·7
	Samalkota*	11·1	+2·5	54·5
	Maruteru*	8·6	+0·5	49·0
	Cocanada	21·7	+13·8	62·6
	Masulipatam	7·5	-0·6	42·7
	Guntur*	12·2	+7·0	42·4
Ceded Dists.	Kurnool	1·6	-1·9	16·1
	Nandyal	2·1	-4·0	19·4
	Hagari*	3·3	-0·3	18·3
	Bellary	1·5	-2·4	13·9
	Anantapur	1·5	-2·2	14·5
	Rentachintala	...	...	...
	Cuddapah	1·6	-3·4	14·5
	Anantharajupet*	1·9	...	...
Carnatic	Nellore	7·7	-0·7	20·0
	Madras	8·3	-3·4	27·9
	Palur*	2·6	-8·2	24·1
	Tindivanam*	0·6	-8·6	17·4
	Cuddalore	3·6	-7·4	21·3
Central	Vellore	1·4	-4·9	19·4
	Salem	1·8	-4·9	34·8
	Coimbatore	4·1	-2·3	17·4
	Coimbatore Res. Inst.*	3·5	-2·2	15·6
	Trichinopoly	1·6	-5·3	17·2
South	Negapatam	3·0	-7·5	20·0
	Aduthurai*	2·9	-5·2	20·3
	Madura	2·6	-5·2	20·9
	Pamban	6·4	-2·6	14·1
	Koilpatti*	3·6	-4·0	14·9
	Palamkottah	3·8	-3·0	18·7
West Coast	Trivandrum	5·2	-5·4	58·7
	Cochin	4·6	-8·6	106·5
	Calicut	4·0	-6·2	127·5
	Pattambi*	...	...	...
	Taliparamba*	5·7	-5·8	122·6
	Kasargode*	9·2	...	125·3
	Nileshwar*	5·7	-4·4	134·0
	Mangalore	10·0	+2·5	159·6
Mysore and Coorg	Chitaldrug	1·9	-2·3	15·5
	Bangalore	2·5	-3·2	28·3
	Mysore	2·4	-3·9	34·4
	Mercara	7·3	-1·4	152·4
Hills.	Kodaikanal	4·8	-4·9	47·8
	Coonoor*	12·7	...	56·4
	Ootacamund*	6·0	-4·5	48·4
	Nanjanad*	4·6	-2·8	49·5

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

The unsettled conditions in the North Bay of Bengal during the end of last month concentrated into a deep depression on the 1st of this month. In the course of the next two days it intensified into a cyclonic storm in the North-west angle of the bay. Passing rapidly north west wards it crossed the Orissa coast about 4th and lay as a deep depression over Chota Nagpur on the 5th. It then receded and travelling in a north easterly direction filled up over East Bengal on 7th.

In connection with the depression wide spread rain occured in Burma, coastal Bengal, Northeast India and along and near the track of the depression from 1st to 7th. Thunder storms were active in the West coast of the Peninsula during the first four days of the month and later in the Peninsula in general during the latter half of the month. Intermittent thunder showers were also reported in the interval, from Burma, Assam, North East India, Bombay, Deccan, North Madras coast, South east Madras and Malabar.

A depression formed in the South Bay of Bengal about 26th of the month midway between Ceylon and Andamans, intensified into cyclonic storm and lay centred 200 miles to South East of Madras on the morning of the 27th October. Later moving Northwards it crossed the Circars coast on 28th and lay as a depression over Hyderabad on 29th. Thereafter it moved to near Nagpur where it weakened and filled up by 31st. In association with this depression wide spread rain occurred in North Madras coast, Orissa and Central Provinces. It also tended to strengthen the North East monsoon which had begun to establish itself over the South Bay of Bengal during the latter half of the month.

The cyclonic storm accompanied by heavy rains according to newspaper reports has caused considerable damage to life and property in North Madras coast.

The month's rainfall was in large excess in the North Madras coast and in defect elsewhere in the Peninsula.

The skies were moderately to heavily clouded.

The chief amongst the heavy falling of rain were Cocanada 11·1" and Gopalpur 6·1" Cocanada 5·0" and Vizagapatam 3·9".

Weather Report for the Research Institute Observatory.

Report No. 10/36.

Absolute maximum in shade	...	92·0° F
Absolute minimum in shade	...	67·0° F
Mean maximum in shade	...	87·7° F
Departure from normal	...	-0·1° F
Mean minimum in shade	...	70·5° F
Departure from normal	...	+0·3° F
Total rainfall	...	3·51"
Departure from normal	...	-2·24"
Heaviest fall in 24 hours	...	0·98"
Total number of rainy days	...	10 days.
Mean daily wind velocity	...	1 4 M. P. H.
Mean humidity at 8 Hours	...	79·2%
Departure from normal	...	+0·3%

Summary: In association with thunder storms activity rain occurred on the first two days of the month and later in the second half of the month. The maximum temperature was almost normal. The minimum temperature and the Humidity were in slight excess by 0·3° and 0·3% respectively. The skies were moderately to heavily clouded.

Rainfall was in large defect.

Departmental Notifications.

Appointments. Mr. P. Krishnaswami, B. Sc., Ag., Fieldman, Millet Section, Coimbatore, is appointed to officiate as Assistant in the Millets Section in Category I class 1, Madras Agricultural Subordinate Service iii grade on Rs. 75 in one of the temporary posts sanctioned in G. O. No. 178 Dev. dated the 6th February 1936 and is posted to the Dry Farming Station, Hagari. Mr. P. Krishnaswami though appointed as temporary assistant in the Dry Farming Scheme, will be counted to be on probation against one of the newly sanctioned posts in the regular line (Agricultural Section) from the date of his joining duty as assistant.

Transfers. M. R. Ry. K. Ramanujacharya, Agricultural Demonstrator, Ongole, to be on special duty in connection with the opening of cattle farm—to report

himself for duty to Mr. R. W. Littlewood, special officer. M. R. Ry. D. C. Hanumantha Rao, Agricultural Demonstrator under training at Guntur—to officiate as Agricultural Demonstrator, Ongole Vice No 1. M. R. Ry. B. L. Narasimhamurthi, Assistant in Millets, Dry Farming Station, Hagari is transferred to Guntur to officiate as Assistant in Millets *Vice* Mr. T. Narayana Rao granted leave. M.R.Ry. L. Krishnan, Agricultural Demonstrator on relief from the viii circle, is posted to Tanjore sub circle. M. R. Ry. T. A. Rangaswami Iyengar, on relief by No. 1 is posted temporarily to Nannilam sub circle, as soon as an additional hand is posted to this division he must go to Arantangi. M. R. Ry. K. C. Thomas on return from leave will join duty as a temporary measure, as Agricultural Demonstrator, Gobi, and take charge of it from the Agricultural Demonstrator, Erode. M. R. Ry. T. K. Thangavelu, Agricultural Demonstrator, Vans, after handing over charge of the van to the Salem District will take charge of the Gobisun circle from M. R. Ry. K. C. Thomas. Orders regarding further posting of M. R Ry. K. C. Thomas will issue later on.

Leave. Principal's Section. M. R. Ry G. R. Venkatachalapathiraju, Assistant Farm Manager, Botanic Gardens, Coimbatore is granted leave on average pay for one month from 1st December 1936 preparatory to retirement.

I Circle. M. R. Ry. M. Satyanarayana, A. D. Pithapuram is granted leave for one month and 22 days with effect from 1—11—36 with permisson to suffix Xmas and new year holidays.

III Circle. M. R. Ry. C. S. Balasubramaniam, Assistant in Entomology, Bellary is granted leave on average pay without medical certificate for one month and nine days from the 14th November 1936 with permission to prefix the holiday on the 13th November and suffix the Christmas and New year holidays from the 23rd December 1936 to January 1937.

V Circle. M. R. Ry. R. Koladavelu Naicker. D. Peravurni is granted leave on average pay for 3 months from 16—10—36. M. R Ry. V. S. Narayanaswami Iyer, A. D. is granted extension of leave on average pay on medical certificate for 4 months from 24 - 10 - 36 to 23 - 2 - 37.

VI Circle. M. R. Ry. Kannapp Pillai, Assistant Farm Manager, Agricultural Research Station, Koilpatti under orders of transfer to the vii Circle is granted leave for 2 months and 5 days from 18th October 1936 with permission to suffix the Christmas and new year holidays to his leave subject to eligibility.

VII Circle. M. R. Ry. A. Ramalinga Iyer, Agricultural Demonstrator, Tiruchendur, is granted leave on average pay without medical certificate for three months from 10 - 11 - 36 or date of relief by the Agricultural Demonstrator, Srivaikuntam, who will be in additional charge of Tiruchendur sub circle until further orders.

VIII Circle. M. R. Ry. P. M. Appaswami Pillai, Asst. Agl. Demonstrator, Hosur, is granted extension of leave on medical certificate for one month and nine days from 14 - 11 - 36 with permission to suffix Christmas and New year holidays.

Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

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Editorial.

Agricultural Improvement and Madras Provincial Economic Council. We publish elsewhere in this issue of the journal, the recommendations made by the sub-committee appointed by the Madras Provincial Economic Council to examine the question of rural welfare and improvement of agriculture of this Presidency. We are gratified to note that they cover a very wide field and commendably aim at the introduction of efficiency in the existing channels of amelioration of the peasants. We feel sure that they would receive general approval of the discerning public. We appreciate their suggestions with regard to the training of rural guides, opening of a fruit section in all Agricultural Stations, employment of agricultural graduates in every High School, the granting of *takkavi* loans by the Deputy Directors of Agriculture, castration of scrub bulls, utilisation of the underground water resources, training men in fruit preservation, and the introduction of the system of controlled credit in the village co-operative credit societies.

The recommendation of the sub-committee on the growing of crops on the cultivable waste lands of each district does not however commend itself to us. In most of the cases these lands are left in that condition by the villagers on account of their being situated in an

unhealthy locality, or of their unsuitability for cultivation being either too shallow or alkaline to grow crops. It has to be remembered that it is not sound economics, particularly so in days of low prices, to carry out farming on lands which generally allow of a little or no profit to the grower. The fact that the neighbouring farmers are loath to till them is a definite index of their falling under any of the above categories.

It is not known how the subject of training of agricultural graduates in rural economics could have evoked difference of opinion amongst the members of the sub-committee in view of the generally accepted fact that out of all the ancillary sciences essential for success in farming, book-keeping holds a very important place and that a knowledge of economics will be valuable in framing an efficient cropping of a farm.

We feel that sufficient stress has not been laid on the measures leading to the prevention of avoidable waste and maintenance of soil fertility.

The portions dealing with the education of the farmers might with advantage have been more specific and thorough. There is a growing tendency in the villagers to love ease to the detriment of agricultural production, to migrate to the town on the score of lack of certain amenities, and to waste time and wealth not only on unproductive but also on destructive pursuits. It is incumbent on the part of all workers in the field of rural improvement to direct their attention to changing this mentality and widening the outlook of the present and prospective farmers. We would rather lay greater emphasis on the latter class of the village population. We are glad to read in this connection a recent press communique issued by the Government on the reorganisation of elementary education in this Presidency, and that a committee has been appointed to go into this important problem and suggest measures. Any recommendation on these points, had it been made by an influential and authoritative body like the sub-committee of the Provincial Economic council, would have been most opportune, as that might enable the Government to arrive at correct and speedy decisions. We would recommend, while on this aspect, the adoption of the method said to be pursued with success in Canada and U. S. A. and also in the peasant University of Zagreb in Jugoslavia, with necessary modifications suited to our Presidency. In those countries small plots of ground are allotted to boys in each village school and crops are raised according to the latest methods under the supervision of the expert teachers. Special scientific staff are appointed to give them instruction on agriculture, horticulture, rural economics, public health and personal hygiene. Weekly lectures are given on ethics, poetry, psychology, fine arts with the object of making them appreciate the dignity of labour, value of

truth, ability to look-ahead, and efficacy of united action for common good and happiness. We would like to add to the above list that arrangements should be made to instil selfconfidence in their minds by taking them periodically to places of agricultural interest and explaining to them how the various situations are being faced by the cultivators.

The sub-committee of the Provincial Economic Council have felt that their recommendations will not be given effect to on account of financial exigencies. We may suggest in this connection that the Government may be persuaded to introduce measures for diverting a portion of the funds at the disposal of the temple committees, charitable institutions, and insurance companies with a stake in the country, for the noble purpose of ameliorating the condition of the villager whose forbears and relatives have mainly contributed for the establishment of these concerns. We would also urge that the promoters of 'Pinjrapoles' and 'Goshalas' should be encouraged to take up the work of maintaining stud bulls and the rearing of calves of typical breeds of cattle for the benefit of the poor agriculturist—the ultimate carrier of all burdens in the land.

NOTICE

All unemployed old students of the Agricultural College, Coimbatore, can continue to be members of the M. A. S. U. at the concession rate of Rupees Two only, by an application to the Manager, M. A. S. U.

KOLE CULTIVATION OF RICE IN THE MALABAR COAST, WITH SPECIAL *REFERENCE TO INSECT PESTS* *

BY T. V. RAMAKRISHNA AYYAR, B.A., Ph. D.,
AND
K. P. ANANTHANARAYANAN, B.A. (Hons.)

Introduction. The peculiar method of raising a crop of rice known locally as *Kole cultivation* appears to be a practice existing only along the Malabar coast, especially in the Southern parts of the British District of Malabar and the native state of Cochin; and as far as the writers are aware the practice has been in vogue in these tracts for several decades in the past. The choice of the land selected for this purpose and the special methods employed in that connection reveal a considerable amount of ingenuity and skill on the part of the inhabitants of these localities even in those early years to utilize all available possibilities to add to their income from mother earth.

II The Physical Features and Topography of the Kole Land. The lands utilized for the Kole crop are beds of two or three fresh-water lakes which ordinarily contain water to a depth of three to six feet for over five months in the year from June onwards. It is reported by some of the old residents of the areas that these lake beds were primaeval forests which gradually became lakes, and that large logs of very old and partly burnt wood discovered now and then while digging testify to this. These lakes are bounded on the east by the submontane areas of picturesque fields and gardens extending to the foot of hills of the forest-clad Western Ghats, and on the west by the narrow belt of backwaters lying in close proximity and parallel to the Arabian sea coast with which these are also connected in one or two places. For more than half the year, *viz* from the time the southwest monsoon sets in with its heavy and continuous downpour of rain, these areas are full and appear as expansive sheets of water and quite deserted, and no stranger to the locality will be convinced if he is told that these tracts are cultivable areas. With the approach of early summer in January the whole area becomes gradually metamorphosed. Streams of labourers, fleets of boats and pumping machinery of various kinds appear on the scene, and the whole area throbs with human activity; and by April or May the quite water covered lake of the previous autumn is completely changed and presents a most beautiful amphitheatre of green smiling paddy fields enclosing a remarkable net work of large and small irrigation canals. The whole landscape at this time of the year presents a most interesting and charming scenery

* Paper read at the Indian Science Congress 1936.

rarely met with elsewhere. One such Kole area is the Enamakkal lake situated at the extreme south of the Malabar District with a part of it lying within the limits of the Cochin State. This lake covers an area of about 25 sq. miles and is the best and typical example of one of the Kole areas known. The whole area brought under Kole cultivation along the West coast every year roughly comes to not less than 7,000 acres.

III System of Tenure and Preliminary Preparations. These extensive Kole areas generally belong to a few wealthy landlords called *Jenmis* who lease out these areas to different lessees who may in their turn sublease their portion into smaller holdings so that one big area like Enamakal tract will generally be the property of about half a dozen wealthy landlords and actually cultivated by several tenants and subtenants. Each kole area is generally divided into what are known as '*Padavus*' and this partition into smaller pieces is facilitated by the net-work of main and minor irrigation channels which also act as boundaries. By about the beginning of December when the water level, in the lake subsides, the remnants of the boundaries of the canals become visible and the work of repairing and strengthening their bunds is started in earnest all over the tract. At the same time the one or two openings (through the permanent embankments maintained by the state) by means of which these lakes open into the backwaters towards the west are closed in order to prevent the flow of salt water from the backwater into the Kole areas. The work of repairing, raising and strengthening the embankments and bunds of the various channels in the area forms one of the most important items of work, and obviously in most of these preliminary operations, a good deal of co-operation is and has to be displayed by the cultivators. Boat loads of gravel, bamboo skates, matting and straw are brought from the mainland for these purposes and the bunds are gradually raised to a height of 4 to 5 ft. and strengthened. As this work proceeds the water level in the cultivable area gently goes down and pumps of different kinds are employed to pump up the remaining water into the adjacent canals. In the old days wooden Persian wheels and other manual devices were employed to bail off the water from the low-level areas into the adjacent high level channels, but now-a-days with the advent of high power steam and motor engines, this work of pumping up the water is very much facilitated and done expeditiously. During the early summer months, numerous such pumps are installed at the main bunds and will be found at work, and for some days the murmer of these pumps and the noise of the pumped water can be heard continuously night and day. This work of pumping out water from these areas is often undertaken by contractors who own pumps and who get a good remuneration from the cultivators and now-a-days, of the two parties, the cultivator and the water-pumping contractor, while the former has to brave risks of

different kinds, the latter is sure of his income and has absolutely no risk to run since he is assured of his charges for pumping the water whatever happens to the crop. Incidentally we may add that in this way the Kole cultivation has substantially helped engineers and contractors to make large profits compared with those of the actual cultivator.

Next in importance to the pumping up of the water and exposing the lake bed is the problem of clearing the rank growth of weeds. This is a fairly tedious operation and numerous coolies are employed in their removal and collecting them into heaps. One can get an idea of the magnitude of this weeding operation if one is told that there are generally from 8-10 such heaps of weed, to each acre, each of these from 6-7 feet in height and about 6 feet across the heap! It is almost an impossible task to completely clear the weeds. These heaps when dry are burnt and turned to ashes to be used as manure later on. There is hardly any ploughing done, the only cultural operation being the drawing of a wooden harrow-like implement (a horizontal stout piece with numerous short spikes) over the surface of the smooth miry surface and then levelling the same with a long flat piece. Excepting the high channel bunds and the important embankments which still retain their framework, all the small narrow field bunds are almost completely erased by the floods of the previous year and have to be remade; this is usually done by erecting a line of weeds covering them with wet soil and fixing strong bamboo skates along the canal banks. These bunds being new appear clean and absolutely without any growing weeds to start with. In each *Padavu* or block all the preliminary operations occupy a fortnight's time and it is during this period hundreds of coolies from far off villages find occupation in the area.

IV Sowing Seeds and Irrigation. Soon after the land is prepared as before and the necessary arrangements made to get rid of the extra water and preserve the water necessary for future irrigation the seed is sown broadcast in the puddled lake-bed. It is needless to add that the area thus utilized is extraordinarily fertile; the soil is a sort of blackish soft mire mostly composed of large quantity of silt and organic debris deposited by the huge mass of water. The variety of seed used for the major portion of the area is a short-duration variety known locally as '*Cheera*', though occasionally other varieties like '*Ponnaryan*' and '*Champa*' are also used. The seeds are soaked in water in bags or baskets for 12 hours and kept wet for about 30-40 hours and the half sprouted paddy is sown on the 3rd day. The seeds remain exposed on the soil surface or a little below. In 3 to 4 days they give rise to white sprouts and green leaves open out. The sown plots are allowed to dry and crack for about 10—20 days before water is again

let in from the high level channels. In some portions where swampy conditions always prevail transplanting is done, and, for this nurseries are raised in high level areas at the outskirts of the lake. The major portion of the sowing is completed in the course of about 15—20 days. The baled off water which is held in the canals at a much higher level, as stated before, serves as a reservoir for supply whenever needed. The whole area in about 10 days after sowing presents a picturesque show with a vast area of green verdure enclosing and surrounded by numerous channels of different sizes full of water, much above the level of the crop in the fields. A close watch is made day and night by respective lessees to prevent any leak in the bunds; for, a breach at this stage will undo the whole work over large areas. In borders and outskirts away from channels, if the plots dry up too soon, before the seeds are fully germinated irrigation by splashing or by means of Persian wheel is given. By the time the plants are 6 inches high, the plots are fairly dry and water is let into the fields from the main and sub-channels. Sometimes necessity to refil the feeder channels by pumping back water from the main channels also arises for fields sown in somewhat higher levels. In later stages when the channel water supply is exhausted, the crop has to stand the chance of a rain or two. Occasionally a '*Padavu*' or two lying uncultivated in swampy situations in the middle, may also serve to supply water as necessity arises. Thus the crop grows and comes to harvest by the end of April or early in May without much by way of further operations on the part of the cultivator.

Transplanted crops of Ponnaryan or Champa are also found occassionally in detached areas. Though transplanting gives a comparatively higher yield it is seldom practised due to the additional labour involved, want of suitable plots for raising nursery in the near vicinity, and the inordinate delay necessitated in the actual process of planting such vast areas as compared with broadcasting. In fact transplanting is resorted to only in such plots 'where the soil condition is such that it cannot be brought to a suitable condition to broadcast the seeds, due to the persisting damp conditions or the existence of natural springs.

V Harvest and Yield. Under normal conditions in the locality, a heavy yield of paddy results. On an average, an acre yields 200-250 '*parahs*' (1 para = about 7 m. m,) of paddy i.e. 20-25 times the seed used. From local inquiries made by the writers the cost of cultivaation appears to come to approximately Rs. 30—35 per acre, as follows:—

1. Bailing water	Rs. 10—12—0.	2. Trimming bunds	Rs. 10—0—0.
3. Cost of seed	Rs. 5—0—0.	4. Weeding	Rs. 2—8—0.
5. Sundries	Rs. 2—8—0.		

The yield after paying dues in kind for harvesting, threshing etc, comes to Rs. 100—125 (if the price of paddy rises, the income is more). The cost incurred in connection with combating insect pests or in connection with unexpected early floods before harvest is sometimes considerable.

A long duration swampy variety of paddy is also grown in small scale in the flats near the borders of the lakes from March to December. This crop grows and with the rising floods the plants always keep above the level of water ; harvesting is mostly done here in boats. Due to increased facilities for draining or irrigating the land by use of pumps, the typical summer crop is raised of late on an extensive scale.

In case the summer rains are late, cattle are allowed to graze in the fields which will be full of green grass after harvest. Ploughing is also done here and there if conditions permit.

VI Insects of the Kole Areas. The Kole cultivator is at once familiar with two important pests viz. the swarming caterpillar of paddy (*Spodoptera mauritia* Boisd) locally known as '*Karakotti*' and the ricebug (*Leptocorisa acuta*) known as '*Chayi*.' Next in importance are the Rice hispa (*Hispa armigera*), the stem-borer (*Sehoenobius incertellus*), the climbing cut worm (*Cirphis albistigma*), the case worm (*Nymphula depunctalis*) and the leaf roller (*Cnaphalocrocis medinalis*). Oher insects of minor importance, are the green and white Jassids (*Nephotettix bipunctatus*, and *Tettigoniella spectra*), the rice thrips *Thrips oryzae*, *Leptispa pygmae*, *Dasychira securis*, *Oxya velox*, *Parnara mathias* and *Prodenia sp.*, which appear at several stages of the growth of the crop.

Spodopetra mauritia, (Boisd) This pest occurs on a large scale and does considerable damage to the crop almost every year. The caterpillars are first noticed by cultivators when they are about two weeks old in crops of 3 to 4 weeks' growth especially when they cut leaves and do appreciable damage to the crop. But the actual infestation starts quite earlier and is little noticed. Usually the ryots' practice of keeping the plots dry for a period of a fortnight and then suddenly flooding the crop, reduces to some extent the severity of attack. More sensible ryots if they happen to see the small caterpillars keep the crop wholly submerged for 2 or 3 days, and then sweep the floating caterpillars with brooms and destroy them. Often a floating raft made of brambles and green twigs is made and dragged over the submerged crop and by this means a large number of the larvae are collected out of the crop, and water let out to the desired level. In the absence of sufficient water supply, the ryot is practically helpless. Fortunately the pest is never found to occur a second time in the same crop. The grown up caterpillars are eagerly singled out and greedily devoured by ducks which are reared in thousands around these localities.

2. The notorious rice bug (*Leptocorisa acuta*) is another injurious pest causing very serious damage at the flowering stage ,of the crop. The bug quickly multiplies in numbers in the numerous grasses and in the swamp paddy at the outskirts of the lake, almost all through the year. In the vast area of paddy the ryots' attempts to capture them are of no avail, and this bug is in some seasons known to cause more damage than any other pest.

3. The rice hispa, the case worm and the leaf-roller appear in stray plots in such large numbers as to disfigure the foliage, and cause a sickly appearance to the early stage of crop which however, recover later on automatically with advance of growth. The egg-masses of the paddy stem borer are found in plenty, as soon as the water is let in, but the later vigorous growth of the crop and with the advance of hot weather, it becomes scarce. Climbing out worms (*cirp his spp.*) appear during certain years and cause some appreciable damage to earheads. Isolated caterpillars of Prodenia start along with Spodoptera, but they prefer to grow on the weeds in later stages. Thrips Oryzae, Leptispa and the Jassids are not known to do any serious damage though visible in early stages. Dasychira, Parnara and Oxya are found in small numbers almost to the time for flowering.

It will be seen that almost all important paddy pests are found on Kole paddy, but the more important and serious ones during most years appear to be the swarming caterpillar and the ricebug.

VII Conclusion. It will thus be seen that Kole cultivation presents a unique method of crop growing and offer multifarious opportunities for studies in different directions to all interested in the various aspects of agriculture and allied sciences. To the entomologist it affords exceptional opportunities to study the bionomics of insects under unique conditions. No less important is the field for the zoologist who can get a varied collection not only of fresh water fauna, but also other animal associations such as birds, reptiles etc. The avifauna of this region is extremely remarkable and the ornithologist will find here an ideal spot for game shooting. Of immense value, may be the study of the weeds and vegetation of the locality to the Botanist. The study of the changing conditions of the soil in this area will no doubt interest the chemist and bacteriologist as well. The sudden changes in the atmosphere brought about by the removal of water, drying of the fields, and concomitant rise of crop in a large scale together with the prevailing influence of hot weather also offer exceptional opportunities for the Agricultural meteorologist for the study of the micro-climate of crops. The authors have only attempted to give a general out-line of this interesting practice and those who are interested in the details of this subject will find ample scope for further scientific investigations.

THE PROVINCIAL ECONOMIC COUNCIL

BY RAO SAHIB V. MUTHUSWAMI IYER,

Retired Lecturer in Agriculture, Coimbatore.

The recommendations of the Sub-Committee of this Council have just been published (vide official summary published in the 'Hindu' dated the 17th October 1936).

In these days of universal economic depression and acute unemployment, it is satisfactory to note that the Committee urge "an enquiry into the subject of rural income and standard of living". One would however think that this is too vast a subject for a purely advisory body like the Economic Council effectively to undertake.

That the matter of standardisation of weights and measures should, in the opinion of the Committee, be deferred until after the inauguration of the New Constitution is unfortunate. That the primary producer and the consumer have long suffered and are suffering from the inequities of the existing system is a well known fact. The subject is non-controversial and no one would murmur if the Council had pressed upon the attention of Government the urgency of a measure of reform in this direction which is overdue.

The public would welcome the suggestion of the Committee that Breeding Stations and Sub-stations for paddy may be opened in Vizagapatam, Chigleput, Kistna, Nellore, the Periyar area in Madura, Tinnevelly and South Kanara. It is to be noted that this recommendation has reference chiefly to rainfed areas and coastal districts. Tank-fed areas in the interior are not negligible and deserve better attention than has been accorded by the Council.

The Committee rightly stress the need for attaching a fruit section to all Agricultural Stations where conditions permit but, it is feared, that they overstep the limit when they suggest that the area of the farms at Samalkota, Aduthurai and Pattukkottai should be increased by 35, 15 and 15 acres respectively.

Consolidation of cultivation on a co-operative basis with a view to forming large scale farms seems to be a pious hope. Wherever conditions permit, ryots do such cultivation and there are limits to co-operative farming as agriculture is still primarily an industry of the individual in India.

'Economics' has for several years formed an important part of the agricultural course at the Agricultural college. A perusal of the College calendars would show that the Committee has been misled in this matter and that their recommendation in this regard is therefore superfluous.

The Committee make a wholesome suggestion that Elementary Teachers should have training in agriculture but their recommendation that facilities should be afforded at Agricultural Stations seems to ignore the fundamental facts that Agricultural farms are opened under rural surroundings where cultivation is possible and training schools are located in urban areas where pupils are available in numbers. Their recommendation should, in order that it may become practicable and useful, aim at a small area being attached to training schools. These schools should be located in or transferred to localities where such facilities can be secured.

Presidents of District Boards who are *ipso facto* members of the District Economic Councils can very well lead the way, as one or two have already done without any objection from Government, in giving effect to the recommendation that an agricultural graduate should be appointed in every high school to give such instruction as will give an agricultural bent to students. Government will most surely and gladly help in this direction. There can be no doubt on this point.

The recommendation that Government should purchase and maintain and encourage co-operative societies and ryots to purchase and maintain bull calves from ryots and sell them when old enough as breeding bulls, will not receive general agreement of the discerning public. The cost and risk involved in rearing bull calves until they grow and are declared fit for service are so great that no co-operative institution or ryot can in the present state of public finance invest on bull calves as such. Much more than in the case of crop seed, it should form one of the functions of the Development Departments of Government to undertake this piece of work. All are aware that cattle improvement is a slow process and that the cattle farms in this Presidency have not distributed even an appreciable number of bulls in proportion to the total cattle population. In this respect sure and steady work is important, if satisfactory results are to be obtained; opening of more cattle farms will be one solution of this vexed problem.

Revival of Tank Restoration Scheme parties is as urgent a matter as investigation of irrigation projects, the area under tank irrigation being very large. The Kudimaramat system seems in the opinion of the Committee to have failed of its purpose and most would favour the execution of repairs by Government owing to existence of factions in villages.

In regard to underground water and its availability for cultivation five recommendations have been made which deserve careful attention on the part of the authorities. It is not known what action was taken on the survey of underground waters made by the Agricultural Engineer over a decade ago.

Touching the recommendation that Government should undertake in suitable areas sinking of irrigation wells and distribution of pumped water, it may be added that in Chittoor, North Arcot, Chingleput, South Arcot and parts of Ramnad and Vizag where the water table is high, such attempts are likely to be more successful and need earlier attention as the extension of electric schemes to those districts would become possible in the near future.

In the matter of crop improvement, the very striking example set by the Bombay magnate Mr. Walchand Hirachand in awarding a prize of Rs. 1000 to the cultivator of sugarcane who produces 100 tons of cane per acre may very well be repeated by the Government and interested parties in Madras.

In this connection mention may be made of the action of the U. S. S. R. in stimulating production of cotton by paying the growers on a graded scale. "Those who raise 2 tons per hectare are paid at 180-200 roubles per 100 kilogram, and for those raising 3 tons the price is from 230-250 roubles per 100 kilogram, though the price for the "American" raw cotton, grown on the irrigated region, is 110 roubles per 100 kilogram. Likewise, in the non-irrigated regions yield of 500 kilograms per hectare is paid at 151 roubles per 100 kilogram; if the harvest is 700 kilograms the rate is 238 roubles and for one metric ton the rate is 307 roubles."

Further extension of cultivation of sugarcane whether North of Kuttalam in Tanjore District or elsewhere in the Presidency may wait until after the Tariff Board next examines the question of sugar industry in this country in a year or two, as cheap sugar from Upper India where costs of cultivation are smaller cannot be kept out from Madras even under the conditions of provincial autonomy next year.

Most of the other recommendations of the Committee would meet with general approval as they indicate a distinct step forward in the direction of improvement of the ryot's economic conditions.

Time, labour and funds are prime factors and the extent to which these latter are made available will determine the degree of development reached.

With the experience that will accrue of their working in the interval, the new ministry of 1937 one hopes would be in a position to examine the constitution and functions of District Boards, District Educational Councils and District Economic Councils and their relationship with or dependence upon Government departments and to introduce such measures as will tend to make them live units in the Governmental administration.

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1 Rouble = 3 s. 2 d, ; 1 Kilogram = 2·19 lb.

RATIONAL FEEDING OF CATTLE

BY T. MURARI, B. Sc., (Oxon), F, L. S., F. R. S. A.,

Deputy Director of Agriculture, Livestock.

Hindus and Buddhists generally venerate animal life and usually show an aversion to hurt dumb animals. In India, especially the cow is a very sacred animal and the veneration in which it is held, evidently had its origin in man's appreciation of its great usefulness, in supplying milk, milk products, and cattle for the farm and the home, not to speak of the dung and urine, which besides serving as manure, figure prominently in the domestic and religious life of the Hindu. It is amazing therefore, to find, when one journeys through the country, emaciated specimens of cows, which are the result of insufficient feed and improper attention, quite out of keeping with sacredness associated with the cow.

This negligent attitude is reflected even in cities like Madras where the professional milkman maintains the cow through her lactation period and later sells her to the butcher. The humane method of killing animals with the special type of gun called the "humane killer" is not practised. It is usual to see miserable-looking calves with the milkman. The calves generally die, due to lack of nutrition and the milkman has the dead animal stuffed with straw and put before the dam so as to induce her to yield milk. That there should be no public opinion to stop this kind of practice in this country is more surprising.

The ryot who mainly depends on cattle for his crop-husbandry does not usually conserve fodder in the same way as the farmer does in the Western Countries. He generally takes particular care of the bullocks but not of the cow. He feeds them when he has plenty and at other times, lets them find their requirements as best as they can by grazing in dried-up fields and roadsides. Nevertheless the ryot expects the cows to work and produce calves.

Again, both in villages and in small towns, people who are not ryots maintain cows to supply home requirements. This practice may be back-yard dairying. The cows in these cases are generally managed by servants who may be ignorant of the best methods of feeding, and very often the animals do not get a balanced ration although they are expected to give large quantities of milk.

All animals need sufficient food for keeping their bodies in working order. The ration which gives sufficient energy for just keeping the animals in good health without further demand for any useful work is known as "the maintenance ration". It is in addition to this,

that food must be given, for producing milk or for turning out work. This portion of the food is known as the "production ration". These terms, maintenance and production are mainly used for purposes of working out rations in a sensible way, but it must be remembered that in the animal stomach no such distinction occurs. Any food that is in excess of the requirements of the body in normal working order, would either be stored as fat or converted into work, or milk. The type of food given will no doubt vary from district to district, but it should fulfill these fundamental requirements.

The ration should contain what are known as proteins or albuminoids. These are of complex chemical composition and contain 16 per cent of nitrogen, a certain amount of sulphur and sometimes phosphorus, in addition to carbon, hydrogen and oxygen. It has been discovered that there are particular types of aminoacids like cystine and tryptophane, required for particular function of the body growth, milk production etc. It is yet too early to state exactly the minimum requirements of the various types of farm stock. The white of an egg and the caseinogen in milk, glutin in wheat are examples of proteins. Cattle foods such as groundnut, coconut, gingelly and other cakes, and tender green grass, rich in proteins, are called concentrates. Proteins are essential for muscle building. When they are not sufficient the young animals cease to grow, while older ones become emaciated and several disorders make themselves apparent. When proteins are given in excess, digestion and kidney functions are disturbed and unpleasant smelling fæces and gases are produced.

Foods should also contain what are known as carbohydrates. These are composed of carbon, hydrogen and oxygen with hydrogen and oxygen in the same ratio as in water. All starches, and sugar, may be classed as carbohydrates. Grass and straws contain large quantities of carbohydrates. Rice, maize, potatoes, sweet-potatoes, tapioca, and yams also contain large percentage of carbohydrates. These are necessary for producing sufficient heat for doing work or putting on fat. Carbohydrates are also required by the ruminants in particular to satisfy their craving for bulk. If the animals feed mainly on bulky fodder like straw, the abdominal muscles get distended and "Pot bellies" become evident. In extreme cases the energy used in mastication is more than the energy in the food; and the result is enfeeblement and death.

Foods also contain fats which are similar to carbohydrates but are poorer in oxygen. They are found in large quantities in foods like groundnut, gingelly, rape and linseed seeds and coconut cakes. The heat producing value of fat is two and a half times that of carbohydrates. The fat is generally used up in work and when in excess will be deposited in the body as depot fat. When stored as fat it is used up

for work in times of stress. At one time it was thought that carbohydrates could replace fats of equal heat value but it is now being recognised that a certain minimum of fat is required for the well-being of the body.

Substances called Vitamins, the chemical composition of most of which is not yet thoroughly understood, are essential for growth, maintenance of good health and for reproduction. These vitamins have been recognised by their specific effect on the body complex and they have been called vitamins A, B, C, D and E. Vitamin A, was first observed to be in loose association with animal fat and to be essential for the growth of the young. This vitamin has been recently isolated and is known to be clearly related to a group of vegetable pigment known as the carotenes. Green vegetables and green herbage grazed by cattle will no doubt supply this vitamin adequately. It is noted that vitamin B is necessary for the proper function of the nervous system. Vitamin B complex is divided into B_1, and B_2. Vitamin C is well known as a preventive of scurvy, a common complaint when fresh foodstuffs are not available for considerably long periods. This vitamin has been chemically separated and it is now called ascorbic acid. Vitamin D is known in connection with rickets. This vitamin is essential for proper assimilation of calcium, and belongs to a class of substance known as sterols. If this is not present in the food of the growing animal, it could be produced by the body itself by irradiation. At Hosur it was found that the pure white ram lambs could not survive more than six months and were not fit for breeding. By the administration of small quantities of cod-liver oil it was possible to make them grow satisfactorily and to use them for breeding. Vitamin E is also known as anti-sterility vitamin. Absence of vitamin E will lead to a failure in reproductive powers. The chemical action of this has not yet been determined. If mixed feeding with sufficient green herbage is possible, there should be no vitamin deficiency in the rations.

In addition to the above, cattle food should contain sufficient minerals such as calcium, phosphorus, sodium chloride, iron, etc. They are absolutely necessary for bone formation in the young, production of milk and for maintenance of proper balance of health. Tuberculosis in the cases of heavy milkers is considered to be directly due to lack of sufficient calcium in the blood. Col. Matson has shown the beneficial effect of potassium iodide in cases of delayed shedding of calf hair. In general practice very often unthrifty animals have improved considerably after the inclusion of minerals in the ration. At Hosur, the Ongole calves weighed on the average 52 lb. while the average weight at Chinthaladevi in the Nellore district was 62 lb. but when 2 oz. of equal portions of lime and bone flour were given to pregnant animals for about 2 months prior to parturition, the average weight of calves increased to 61 lb. Of late, deficiency of iodine has

been found to affect growth and produce abnormalities. In order to obviate any mineral deficiencies proprietory articles in the form of mineral bricks are put on the market. Experiments conducted at Hosur show that an ounce of common bazaar salt per animal in addition to 1 to 2 ounces of lime and bone flour in equal quantities and rock salt lick for all stock are very economical from the ryot's point of view. The bazaar salt contains enough iodine to make up for any iodine deficiency in the cattle food.

In addition to minerals, water should be given *adlib* to all animals. As the muscles and blood contain a very high percentage of water it is essential that water should be consumed. It also helps in transporting food materials and washing down of waste products in the body economy.

So far the uses of foods have been described. Now the ryot should know how much food to give an animal. The European standards do not apply to Indian conditions. From Ramiah's nutrition experiments conducted at Coimbatore it is seen that the maintenance ration of adult Indian cattle in the Presidency is extremely low as compared with European. 200 grammes* of groundnut cake and 8 kilograms of paddy straw are sufficient for maintaining an adult bullock in good health. Figures for production are not yet available, but in the absence of such figures, it would be quite safe to give 3 lb. concentrated mixture for every 10 lb. of milk produced by the cow; for work-animals 2 to 4 lb. of concentrated mixture depending on work ought to be sufficient. Hay and water *adlib* should be given in order to satisfy the animal.

The following are some of the useful standards for feeding a bullock of about 1000 lb. liveweight, the production rations being added to the maintenance ration for bullock at work.

Maintenance ration.	*Production ration.*
1. 14 to 18 lb. hay	2 to 3 lb. groundnut cake.
7 to 10 lb. straw or grazing	1 to 1½ lb. ricebran.
½ lb. concentrate	
2. 25 to 40 lb. silage	1 to 2 lb. wheatbran
10 to 14 lb. hay	1 to 2 lb. horsegram
7 lb. straw	½ to 1 lb. chenna busa.
3. 20 lb. cholam fodder or hay	2 lb. bran (rice or wheat).
½ lb. concentrate	1 to 2 lb. cotton seed (crushed).
	1 lb. soaked horsegram.
4. 10 to 15 lb. green fodder	2 lb. gingelly cake.
such as lucerne, lab-lab	2 lb. gingelly cake.
and 10 to 20 lb. of some	1 lb. ricebran.
grass or straw.	1 lb. bhusa.
	1 lb. wheatbran.

1 oz. bazaar salt, 1 to 2 oz. lime and bonemeal, rock salt lick and water *adlib.*

Palatability of foods and individuality of the animal should not be lost sight of in animal management.

* 1 lb. = 453·593 grammes.

One is likely to ask whether a ryot could afford to give a liberal ration to cattle. If he wishes to get the best out of his animal, it would be far better for him to keep a less number and look after them properly and sell out the surplus than keep an unnecessarily large number of mediocre animals and underfeed them. At present there are far too many useless cattle in the country. It is a greater sin to starve the animals than to kill those that the ryot cannot possibly feed satisfactorily, as he has to conserve fodder for his animals for the dry period when no proper grazing is available.

A PRELIMINARY NOTE ON THE EFFECT OF HAND DIBBLING ON SOME OF THE CHARACTERS IN COTTON

BY C. VIJAYARAGHAVAN, L. Ag.,
Superintendent, Dry Farming Station, Hagari
and
N. KESAVA IYENGAR, M. A.,
Assistant in Cotton, Agricultural Research Station, Hagari.

The common practice of sowing cotton in breeding plots is to dibble the seeds by hand. This system is preferred to drilling since the quantities of seed material handled are small and the number of units to be sown is very large. In the course of sowing trials conducted on the black soils of the Hagari Agricultural Research Station, differences have been noticed from the very beginning in the mulch of the plots dibbled by the hand and of those sown with a drill. Drill sown plots have an advantage over those sown by dibbling in that the seeds lie uniformly deep in the furrows formed by the drill. The furrows are covered immediately by working a blade harrow and the soil is compacted over the seed leaving a fine mulch on the top. The effect of this harrowing lasts for a long time. In the dibbled plots on the other hand it is not possible to lodge the seed at a uniform depth. Further as no harrow is passed, the top soil gets dry and hard. and starts cracking earlier leading to depletion of soil moisture sooner.

In order to test whether the two methods of sowing affect any of the characters of cotton, observations were made during the season 1934–35 on a pure strain of *herbaceum* (Hagari 1) grown at this station. The two treatments were replicated four times on plots of two cents each.

The characters studied were (1) position of the first fruiting branch, (2) yield of seed cotton per plot, (3) lint weight per seed, (4) weight per seed, (5) ginning percentage and (6) lint length. Samples for the examination of lint and seed weights were collected from 3 locked bolls of weekly pickings and seeds from all the positions of

the lock were taken to form the sample. Only seeds from the third position of the lock were used for the determination of lint length. The results of the studies of the several characters are given in the table.

Table I.

Blocks.	I		II		III		IV		V		VI	
	1st Fruiting Branch		Yield of seed-cotton per plot (lb.)		Lint weight per seed (mgs.)		Weight per seed (mgs.)		Ginning percentage.		Lint length (m. ms.)	
	Hand sown	Drill sown	Hand sown	Drill sown	Hand sown	Drill sown	Hand sown	Drill sown	Hand sown	Drill sown	Hand sown	Drill sown
1. ...	6 9	7·1	1·48	2·22	21·8	23·2	56·2	58 4	27·8	28·4	25·7	26·7
2. ...	7·1	7·5	1·95	2·91	22·0	23·0	55·2	56·4	28·4	29·4	25·2	25·1
3. ...	7·3	7·6	2·39	3·28	21·6	23·8	57·0	58·4	27 6	29 0	25·1	26·4
4. ...	7·2	7·7	2·28	3·75	22·8	24 4	58·6	59·6	28·0	29·4	26·1	26·2
Mean.	7·1	7·5	2·03	3·04	22·1	23·6	56·8	58·2	28·0	29·1	25·5	26·1
t value*	5·0		5·1		5·2		5·0		5·8		2·0	

Yield in pounds of seed cotton per acre = 224 365

Percentage of increase over the hand sown = 33

* t value for P = ·05 and $n = 3$ as per Fisher's table = 3·182.

N. B.—Differences are significant in characters I to V but not significant in lint length (VI).

The following conclusions are evident from the table:—

1. The first fruiting branch arises earlier in the hand sown plots. It indicates that the reproductive phase is initiated earlier, possibly due to lack of moisture in the hand dibbled plots.

2. Hand sowing depresses the yield by 33%.

3. Lint and seed weights are also lowered in the dibbled plots.

4. The ginning percentage is reduced indicating thereby that the rate of fall in lint weight is greater than in the case of seed weight in the hand sown plots.

5. Lint length is not affected.

Further studies are necessary before any explanation can be offered for the above behaviour.

THE FINAL YEAR STUDENTS' TOUR

BY A. V. PITCHUMANI, Class III.

The eagerly expected fortnight's tour of the Final year B. Sc. Agr., students commenced on the 1st of October. We were a jolly batch of twentyfive and we met at Ongole in the early hours of the 1st October. This tour was intended mainly for the study of cattle breeding with special reference to the Ongole and Alambadi tracts. During our two days' stay at Ongole we visited the neighbouring villages of

Karavadi and Tangaturu—two important cattle centres in the Ongole tract. Our stay at Ongole was very happy and useful. While leaving that place we carried with us vivid memories of the excellent cattle reared by almost all classes of ryots, of the majestic Brahmini bulls which are so common in all the Ongole villages, of the well preserved pastures—indeed of all those things which the Ongole ryot so intelligently and carefully does as to maintain a fine breed of cattle. Our class played volley-ball and tennis matches with the Ongole Mission High School and won both of them creditably.

Our next visit was to Narasaraopet which we reached on the 3rd morning. The same evening we visited a neighbouring village where we made enquiries regarding the local agricultural practices of the tract. The next day we paid a visit to Chilakaloorpet—a flourishing village of agricultural importance—where we studied the methods of citrus and guava cultivation. On the 5th we had a very pleasant and instructive trip to the Guttikonda forests, thirtyfive miles from Narasaraopet. There we saw the forest tribe, the Lambadis, whose chief occupation is cattle rearing. Hundreds of cattle, generally of poor type, from the neighbouring taluks are brought to be left here under the charge of the Lambadis in June-July. These cattle are taken back by their owners usually before" Pongal" in January. Before leaving these forest grazing areas or *pentas* as they are called, we were entertained to a nice dance by these Lambadis.

On the 6th we left for Nandyal. The journey especially through the Nellamala forests was exceedingly pleasant and we were enthralled by the sublime scenery which Dame Nature has showered upon those regions. Undulating forests, deep valleys, fearful tunnels and screaming streams, all these captured our imagination. On arrival at Nandyal, we went round the Agricultural Research Station, where we were shown and explained the various experiments and the selection work carried out in the Farm on the dry crops of the Ceded Districts. The next day we visited Panyam, a neighbouring village noted for its fruit cultivation. Here we saw the gardens and nurseries of Messrs R. V. Madhava Rao Bros. and got first-hand information regarding citrus and mango cultivation, budding grafting topworking. Mr. Hanumantha Rao the joint owner of those gardens explained to us the various details very clearly, and also arranged a nice exhibition of the various specimens and varieties of fruits grown by him. After a delightful evening party and group photo arranged by him in his beautiful gardens we returned to Nandyal. We reached Bangalore on the 8th October. Thanks to the untiring efforts of Mr. Vasudeva Rao, veterinary surgeon, Hebbal, who was deputed by the Government of Mysore to look after our comforts, our stay at Bangalore proved most instructive and enjoyable. We visited Hebbal next morning.

Dr. Badami, the Economic Botanist of Mysore and his assistants provided a fund of knowledge to the students. We were impressed with the amount of work turned out here, especially in livestock and plant breeding sections. To Dr. Badami in whom we saw a rare combination of an enthusiastic scientist and a pleasant conversationlist, we were sorry to bid goodbye after an entertaining tea. In the evening we visited the Imperial Dairy Institute where the officers and staff were kind enough to take us round and explain the various operations in the Institute. When we were leaving this model dairy our little voices began to question, "When will our India see such dairies on an extensive scale ?".—That cleanliness, those students in tiptop clean overhauls looking just like blooming nurses, all left echoing impressions in our mind. Our stay at Bangalore was happy throughout.

Our next place of halt was the Hosur Livestock Research station. While nearing Hosur we could hear the rumblings, "They play cricket and speak English", I mean the farm coolies. Our expectations were materialised the next day when a Bangalore cricket team visited Hosur and Lieut. Murari, the Deputy Director of Livestock turned out with a strong team and routed the visitors. We were none the less responsible for the success (in as much as we lent the services of two of our colleagues.) Hosur is about 3000 ft. above sea-level. With a salubrious climate and rolling pastures, it is an ideal place for a holiday resort for a pick-me-up. At the farm we had a look at the Dairy and the Livestock section and were much impressed especially with "poultry keeping and pig rearing". We also visited the Government Sericultural seed farm run for the benefit of the Kollegal silk industry.

After we left Hosur, our tour during the next few days was so speedy and so full of adventures that we little realised that it was coming to a close until we reached Coimbatore. Karandahalli, Dharmapure, Pennagaram and Kaveri were successively visited and we remember vividly the sturdy herd of Alambadi animals and our dip in the Cauvery falls. It was an exquisite pleasure for all of us to have had a wonderful bath in the sacred waters of the great Cauvery. It was a wonderful sight to see the ever green steep valleys as the buses groaned along the metalled ribbon to the falls. One may be tempted to question what impressions we carry of the tour. It is difficult to give a definite answer. No doubt we can differentiate between an Ongole, an Amrithamahal, a Kangayam and an Alambadi. "Is this all"? one may ask. No. Every thing is there in the subconscious mind, so vivid as to be at the beck and call of our conscious mind. The characteristic agriculture of Nandyal, Ongole, of the Mysore plateau and the hills, their soils, their people and their manners and customs, they jump up vividly and quickly. We went, we saw and we returned more experienced and better informed than before.

We students, scarcely realise the debt of kindness of filial love shown by the various officers and others who were responsible for our well being, which still remains unredeemed when we thank them heartily. Our sincere thanks are especially due to Messrs E. K. Nambiar and P. A. Venkateswara Iyer who were in charge of us throughout the tour and who showed a remarkable degree of patience and forbearance towards us and made this tour of ours a great success. Once again we thank all those officers and others who were of great help to us during the tour and were mainly responsible for the success of this instructive and enjoyable tour.

RETIREMENT.

During the last month, two of the senior members of the Madras Agricultural Students' Union, Rao Bahadur S. Sundararaman and Rao Saheb C. Narayana Iyer retired from Government service.

Rao Bahadur S. Sundararaman was born in the year 1881 in the Tanjore District. His earlier years were spent at Saidapet under the beneficent influence of his father who was then the Vice Principal of the Teachers' College. He graduated from the Presidency College, Madras taking the M. A. degree in Botany with high honours, winning the Pulney Andy medal. In 1905 he entered the Madras Agricultural Department as an assistant under the Economic Botanist. An outbreak of a virulent disease of palmyras and the prevalence of sugarcane redrot in the Godavari and Kistna districts focussed the attention of the Madras Government to the need of Mycological investigations in this province and Dr. Butler, Imperial Mycologist, was requested to undertake the investigation. Mr. Sundararaman who had received his Mycological training under Dr. Butler himself was posted to help him. In this work he acquitted himself creditably and Dr. Butler was greatly impressed with the enthusiasm and earnestness of his young assistant. In his memoir on the palmyra 'Bud-rot' disease, Dr. Butler has recorded his appreciation of Mr. Sundararaman. The training he received from this eminent scientist in the early years of his service was a great asset which stood him in good stead and enabled him in later years to become a successful Mycologist. He was appointed in 1910, chief assistant to Dr. McRae, the first Madras Governent Mycologist. In June 1920 he was admitted into the Madras Agricultural Service as Assistant Mycologist, a post which he occupied but for a short time; when Dr. McRae was transferred to Pusa as Imperial Mycologist, Mr. Sundararaman was appointed Government Mycologist in the Indian Agricultural Service.

This was no mean distinction, for it must be remembered that the entry of Indians to the Imperial Service was restricted to a very limited number.

From 1920 till the date of his retirement he continued to be Government Mycologist. For over 2 months he was in addition, in charge of the Principalship of the Agricultural College. In recognition of his service to Government, Mr. Sundararaman was conferred the title of Rao Bahadur in 1936. As a Mycologist, Mr. Sundararaman devoted his attention more towards such of those problems which were likely to be of immediate practical utility and benefit to the ryot than those which were purely of an academic interest. Gifted with great common sense and a shrewd insight into the psychology of the ryot, the methods he advocated were always readily accepted by the cultivator. Of a shy and reserved nature, Mr. Sundararaman shunned the lime light and hated advertising himself, but did not, on that account shirk any honorary duties that were imposed on him. As president of the Officers' Club (1929), Association of Economic Biologists (1934), Research Council (1936) and the Government Servants' Co-operative Society (1936), he rendered great service to these institutions.

With the Madras Agricultural Students' Union Mr. Sundararaman has been associated ever since its inception and had the unique distinction of being elected as its Vice President in the Jubilee year. He took a keen interest in Agricultural education and was also closely associated with the Madras University. He was for some time an examiner for the Honours degree examination and the B. Sc. Ag. degree. He was member of the Board of Studies in Agriculture and continues to be a member of the Board of Studies in Botany.

Unostentatious, simple and unaffected in manners, courteous to all and kind-hearted to a fault, Mr. Sundararaman endeared himself to all those who came in contact with him and was one of the most popular officers of the Department. His high integrity, thorough grasp of the principles of plant pathology and an innate capacity for administration made him a successful officer under Government.

Mr. Sundararaman retires after 31 years of useful service and we wish him on behalf of the readers of the Madras Agricultural Journal, long life, health and prosperity.

Rao Saheb C. Narayana Iyer comes of a respectable family in Madura District. He took his Diploma in Agriculture from the Madras College of Agriculture, Saidapet in 1902 and entered the department in 1903. After a few years' deputation to the government farms in Bombay Presidency, he returned to Madras and was employed in either starting new farms or running the already started stations in Bellary, Tinnevelly, Chingleput and Tanjore. In 1906 he was associated with Mr. Benson, the then Deputy Director of Agriculture, in the selection of the present site for the Agricultural College and farm at Coimbatore. For about 4 years he worked in Tanjore in popularising the

economic transplanting of paddy and green manures and his work bore such remarkable results that he was known in the district as the "single seedling Iyer". He is still remembered in the District for the good work done by him then. He worked for 4 years at the Agricultural College as an assistant to the Entomologist. Later on, he was appointed chief teaching assistant at the Agricultural College and was promoted to the gazetted rank in 1918. He was for a number of years in charge of the Cambodia Cotton Improvement work in Coimbatore, which developed rapidly under his careful supervision. As Deputy Director of Agriculture, Coimbatore, he was responsible for developing and shaping the potato agricultural station, Nanjanad. He took enormous pains to introduce cattle power and labour saving implements in the cultivation of potatoes on the Nilgiris. His services were placed for some time at the disposal of the Co-operative Department for the development of the Co-operative Loan and Sales Societies in the Presidency.

During the last 18 months of his service he was at Madras as the Headquarters Deputy Director of Agriculture assisting the Director of Agriculture. Wherever he worked he earned a good name for his enthusiasm and earnestness in his activities.

As a mark of appreciation of the good work done for the Agricultural Department he was awarded by the Government the title of Rao Sahib in January this year. He retired from service on 17th November after 33 years of active and loyal service. We wish him long life and well earned rest.

SCHEME FOR ECONOMIC DEVELOPMENT OF MADRAS PRESIDENCY*

Recommendations of the Agricultural Development Committee of the Provincial Economic Council.

The Provincial Economic Council Sub-Committee which considered problems relating to the improvement of Agriculture and the economic development of the Presidency has submitted its report.

The Sub-Committee consisted of the Hon. Mr. P. T. Rajan, Minister for Development, (Chairman), Rao Bahadur D. Ananda Rao, Director of Agriculture, Mr. T. Austin, Mr. T. A. Whitehead, Mr. F. M. Dowley, Mr. P. T. Saunders, Dr. P. J. Thomas, Dr. B. V. Narayanaswami Naidu, Mr. T. A. Ramalingam Chettiar. Mr. C. V. S. Narasimharazu, Mr. A. Ranganatha Mudaliar, Mr. A. B. Shetty Mr. V. Subbiah Mudaliar, Mr. Hunterboyd, the Rev. Father Basenach, Mr. R. M. Palat, and Rao Bahadur C. J. Paul (Secretary).

Mr. T. A. Ramalingam Chettiar has submitted a short minute of dissent.

The Committee which was appointed in November 1936 considered the following subjects.

(1) The preparation of a ten year plan for development of agriculture in order to make the Province self-supporting in the matter of agricultural production.

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* Reproduced from the Madras Mail, dated 17th November 1936.

(2) Ways and means to co-ordinate the work of the various agencies for agricultural credit and the steps to be taken to give effect to the recommendations contained in Mr. M. Sathianathan's report on agricultural indebtedness,

(3) The standardisation of ways and measures, and

(4) Proposals for a consolidation of agricultural holdings and the prevention of fragmentation.

Four Sub-Committees were appointed to consider these different problems. Sub-Committee I, which had the Director of Agriculture as its convenor, was to deal with (1) the expansion of agriculture ; (2) the improvement of cattle; (3) regeneration of fodder grasses ; reduction of grazing fees and production of leaf manures ; and (4) consolidation of agricultural holdings and prevention of fragmentation.

Sub-Committee II which had the chief Engineer for Irrigation as the convenor, was to report on : (1) extension of irrigation facilities for the development of agriculture ; (2) irrigation wells (3) sinking of irrigation wells in river beds and (4) comparative sinking of irrigation wells.

The Director of Industries was the convenor of Sub-Committee III which was to consider (1) extension of the cultivation of sugarcane in the Tanjore district ; (2) fruit preservation and canning ; (3) the dairy industry in India, milk, powder and like products, and (4) the open pan system of sugar manufacture.

Sub-Committee IV with the Registrar of Co-operative socities for its convenor was to examine (1) the facilities offered by co-operative credit socities, co-operative loan and sale societies and land mortgage banks to the ryots for agricultural and other purposes ; (2) how the agencies for agricultural credit are now correlated and how they can be further co-ordinated ; (3) Mr. Satyanathan's report on agricultural indebtedness ; and (4) the recommendations of the Madras Provincial Banking Enquiry Committee.

The main Committee reserved for consideration by themselves the question of " Weights and Measures".

The several Sub-Committees concluded their labours by the end of April and submitted their reports. The main Sub-Committee considered these reports and reached the following conclusions.

Agricultural Produce. "Many of us do not consider it feasible to make the province self supporting in the matter of agricultural produce", say the Committee. " But we all agree that in view of the growing population of the province there is need for a larger internal supply of rice and other food-stuffs and that it must be the aim of Government to increase the production from the land now cultivated and to bring new land under cultivation.

A five-year plan was drawn up by Sub-Committee II, with this object in view. We are aware that plans and programmes framed years in advance will have to be modified to suit changing conditions and circumstances but this should not deter Government from framing any at all.

Improved seed. We consider that the Agricultural Department should grow in Government farms pure and improved strains of seed stock and sell them to the cultivators. We are convinced that the seed produced at these farms will not be adequate to meet even a small fraction of the requirements of the ryots. The additional seed material required should be secured by the department entering into agreement with the grower, the terms of the agreement being :—

(i) that he will grow, harvest and stock the contracted quantity of seed under departmental control and direction and sell the same as seed material, and

(ii) that he shall be paid a definite rate of fair compensation for such portion of his seed material as remains unsold.

When the supply by this method is also likely to prove, insufficient, the department should buy, stock and sell the balance of the required quantity. The Deputy Directors of Agriculture should be authorised to fix the premium rates as may be fixed by the Director from time to time.

Paddy Breeding Stations. "In our view two more Paddy Breeding Stations should be opened, one in the Vizagapatam District and the other in the Chingleput District for evolving semi-dry, dry, and drought resistant varieties of paddy and varieties suitable for cultivation in the months of September and October in the South-West monsoon. We also consider that small sub-stations for paddy should be opened in the Kistna delta, Nellore, Periyar tract of Madura, Tinnevelly and South Kanara. The Godavary Agency offers room for great development and a farm may be started in that area for work on wheat, fruit and other crops suitable to the locality.

The departmental work so far as coconut is concerned, is now practically confined to the West Coast and in view of the large extent of the area under cocoanut in the Circars, the Committee consider that the Director of Agriculture should be instructed to pay immediate attention to the question of opening a coconut station in Godavari. In this connection we examined the position of the coconut industry in South India and being convinced that the dumping of coconuts from abroad has had very prejudicial effect on the local industry, recommend that an increased import duty be imposed on copra, coconut and coconut oil.

Tobacco Farm. "In our view there is urgent need for introduction of improved varieties of tobacco required for cigars. The Circars afford ample scope for experiments in this direction.

"We recommend that a Cigar Tobacco Farm be opened in a suitable place in the Presidency".

It has been represented to us that the agricultural stations at Samalkota, Aduthurai and Pattukottai are hardly large enough for the work to be done at these places. We accordingly recommend that the area in these farms be increased by 35,15 and 15 acres respectively.

We are glad to note the work being done for encouraging fruit cultivation. We consider, however, that to each agricultural station where climatic and soil conditions permit a fruit section should be attached by extending the station, if necessary.

Propaganda Measures. We are convinced that propaganda and publicity require greater attention and closer coordination.

"We therefore recommend strongly the appointment of a Deputy Director to be in charge of publicity. To aid in the dissemination of new ideas and practices, associations of agriculturists and others interested in the development and improvement of agriculture should be formed in every important village and for every firka, with a central association to coordinate and guide the work of the various local associations.

The assistance of Revenue and Agricultural Officers should be made freely available in the working of these associations. These associations may work under the auspices of the District Economic Councils. The membership of the associations should be limited to actual cultivators, owners of land who cultivate it by hired labour and those who contribute to the funds of the association.

Another effective means of propaganda is the visual representation of the improvements through exhibition vans and films. We understand that the Agricultural Department has already been doing some work in this direction. We recommend that a suitable cinephotographic aud projection equipment be purchased and arrangements made for the production of suitable films for propaganda purposes.

"Each assistant director of agriculture should have a motor cinema van. Each agricultural demonstrator should have a well equipped depot from which he should be in a position to supply ryots with improved seeds and agricultural implements such as ploughs, cultivators, chaff-cutters, bund farmers, hand-hoes, dusting appliances, sprayers etc.

Rural Uplift. "To improve the condition of the rural masses should be the predominant aim of the Agricultural Department. We recommend that trained rural guides be appointed, one for each group of villages to work under the guidance of the District Economic Council. It will be the duty of these rural guides to spread improved strains of seeds and better methods of cultivation, to demonstrate suitable subsidiary industries in the villages, to improve the health and sanitation of the village, to effect reform of diet, to organize farmers' clubs and rural amusements, to improve the artistic side of village life, to improve the livestock in villages and to interest the villagers in the work of rural uplift by all kinds of propaganda. The local officers of all the development departments—Agriculture, Veterinary, Industries, Education and Public Health should render them all the help they can.

" A start has already been made in the Vizagapatam District where concentrated work is being done by demonstration maistries in 9 taluks. The existence of the Agricultural department is being felt by the ryots who have begun to appreciate the work of this department and to take advantage of the presence of the maistries amongst them. It may not be possible to introduce these guides in all parts of the presidency at once. One or two taluks may be selected in each district for the present and the scheme may, if successful, be gradually extended to the entire Presidency in the course of about 10 years.

"The training of rural guides should be the concern of the Provincial Government and we recommend that immediate steps be taken for their training in suitable centres, preferably in agricultural farms and schools, the district staff of the various development departments being used for giving the training.

"The value of cottage industries to improve the economic condition of the ryot has often been emphasized. Effective steps should be taken early to develop these industries. Special officers and committees have examined the question of subsidiary industries in the past. *We feel that there can be no justification for delay in drawing up a plan or programme of work.*

"The evils of fragmented holdings have been long recognised and suggestions have been repeatedly made for the consolidation of holdings. The problem however, is not so acute in the Madras Presidency as in some other parts of India. So far as this Presidency is concerned, we agree with the opinion expressed by the Revenue Commissioner that the experiment should proceed on the line of consolidation of cultivation rather than of consolidation of holdings and, accordingly, recommend that consolidation of cultivation on a large scale on a co-operative basis be encouraged with a view to forming large-scale farms.

"In view of the prevailing unemployment and the likelihood of its assuming greater proportions in the future, we consider that steps should be taken to divert the attention of the educated youth to agricultural pursuits and that facilities should be made available to them.

Land Colonization Scheme. "Land Colonization Schemes for Harijans and unemployed boys, especialls those who have passed out of the Agricultural Schools and College should be formulated.

"The Agricultural Department should investigate the questiou of growing suitable and remunerative crops on the cultivable waste lands available in each

district. A survey of waste lands should be made; the possibility of cultivation by tractors should also be examined.

"Our attention was also drawn to the damage caused to crops by wild animals. We consider that some assistance should be afforded to owners of land in such areas to fence their lands; if the owners refuse to take concerted action, powers should be given to village panchayats to carry out the work provided the owners of not less than two-thirds of the area demand it, the charges being divided amongst them in proportion to the extent of the land owned by each.

"A suggestion was made to the effect that agricultural graduates should be trained in Economics as the business aspect of agriculture is of great importance. We were divided on this question. We agreed, however, to request the Director of Agriculture to examine the system carefully and to take necessary action.

Training in Agriculture. "In order to give an agricultural bias to education, we consider that wherever elementary training schools are located near an agricultural farm, facilities should be provided in that farm for the training of the pupil teachers in agriculture and that in other cases, arrangements should be made at the agricultural stations for the training of teachers' deputed by local bodies.

"We also regard it as essential that an agricultural graduate should be appointed in every High School to supervise and conduct gardening classes to teach nature study and generally to give an agricultural bent of mind to the students.

"We consider that with a view to expeditious disposal of applications for *takkavi* loans, Deputy Directors of Agriculture should be empowered to grant loans np to Rs. 250 to purchase seed and agricultural implements.

"Finally we agree with the other recommendations contained in the five year programme of expansion and suggest that Government should take up the various recommendations we have made in regard to the expansion of the activities of the Agricultural Department and others included in that programme for very early consideration.

"When our recommendations are given effect to, the work of the Department will have expanded considerably. To cope with that increase and achieve full and effective results the staff of the Department should be augmented in the following directions :—

"(1) There should be at least one Assistant Director of Agriculture in each district so that more effective control over the work of agricultural demonstrators can be secured. The question of the need for having eight circles should be examined with a view to reducing their number.

"(2) We understand that Government have recently sanctioned an addition to the strength of demonstrators and that it will now be possible to station one demonstrator in each taluk. We desire that in view of the importance of fruit culture, the expansion of which we have recommended elsewhere, an extra demonstrator should be employed in such of the agricultural stations where experiments on fruit culture have been or would be undertaken.

"(3) We also consider that there should be an assistant to be in sole charge of seed selection work and cultivation of improved strains in millets particularly in the I Circle.

"(4) The posting of a demonstrator for each taluk will not by itself bring about the much needed link between the department and the ryot and in the very nature of things it is impossible for the demonstrator to make prolonged halts and to pay frequent visits to the villages to the extent necessary to establish

and maintain close contact with, and sustain the interest of, the ryot in the improvements advocated. The system of employing maistries on a wide scale in the Vizagapatam district has had a salutary effect and real progress has been achieved in that district. We consider that at least one demonstration maistry should be attached to each firka or unit of 25 villages whichever is less. We trust that Government will find it possible to provide this additional staff of maistries.

Live-stock Improvement. " Closely connected with the improvement of crops is the question of the improvement of cattle. Its importance can be easily guaged by a remark of His Excellency the Viceroy when he presented two pedigree bulls at New Delhi. ' The cow and the working bullock ' he said, ' have on their patient backs the whole structure of Indian agriculture .' The breeding of cattle has been undertaken by Government and the main efforts of the department are now concentrated in Hosur though some work is carried on in Guntur. Dairy herds are maintained at Hosur and Coimbatore. It is unfortuante that the axe of retrenchment should have fallen so heavily on the livestock section. The fine herds of Ongole, bred at considerable expense at Chintaladevi had to be dispersed on the abolition of that farm. We feel that the supply of bulls by the Agricultural Department has in the past been so small that it is imperative to increase rapidly the number of cattle breeding stations in the breeding areas of the Presidency.

" We recommend that a farm be opened in Guntur, in addition to the buffalo-farm which, we learn, is contemplated at Prattur. Another farm may be opened at Vizagapatam for the improvement of the Ongoles. The Kangayams may receive attention at Madura. After the question of improvement of pasture has received the attention of the authorities, the question of starting a breeding station in the West Coast may be considered. Sheep and goats should be added in future wherever suitable.

" Beyond providing the nucleus of pure bred bulls and heifers, no substantial advance can be made through these farms towards the general improvement of the livestock in the Presidency. To effect systematic improvement of livestock other measures have to be taken. Disease control, castration and propaganda have all their share.

Provision of Breeding Bulls. " The main question, however, is the provision of sufficient breeding bulls of the right type. The Government should in our view, select suitable bull calves, purchase them from the ryots, maintain them at their agricultural farms and sell them, when old enough, as breeding bulls. The Government should also encourage the formation of co-operative societies for purchasing suitable calves, and for rearing and selling them as breeding bulls.

" Ryots may also be encouraged to do this with the hope of ultimate purchase by the Government.

" The future work should be mainly concerned with the improvement of stock in the villages. With this end in view, breeding bulls should be distributed to important institutions and individuals who are prepared to undertake their maintenance for the benefit of the public.

" Liberal grants-in-aid should be given to District Boards, Panchayats, Co-operative Societies and private citizens for the purchase and maintenance of breeding bulls. We should aim at supplying at least one bull for each unit of a cow population of 150.

" We attach great importance to cattle shows as a means of improving the breed of cattle. Cattle shows should be organized at least once in every year in

each district under the auspices of the District Economic Council. Intensive propaganda should be carried on through agricultural associations towards the same.

"No permanent improvement can be effected in the breed of our cattle unless energetic action is taken by the authorities to put the scrub bull out of action when necessary. We are of the opinion that Government should take powers to introduce compulsory castration of scrub bulls when in any particular locality there is a sufficiency of breeding bulls.

Livestock Section. "The Committee also examined the question of the future control of the livestock section. The question was whether the livestock section should remain under the Agricultural Department, whether it should be transferred to the Veterinary Department, or whether it should be made an independent section. The subject was considered in all its aspects. The problem really is a matter of administrative convenience. It should be remembered that neither department is complete, but each is complementary to the other under the control of the Minister.

"What is required to-day is an Expert Animal Husbandry Organization. able to carry on scientific breeding control in the villages, combined with systematic castration and disease-control and to ensure that adequate encouragement is given to the conservation and development of natural grazing areas.

"We leave it to the Government to decide the agency to carry out the aim we have in view. Our policy should be to breed cattle for speed and working capacity in the natural grazing areas and, concurrently, along with the systematic development of a dairy industry, to breed cattle in suitable areas strictly for the highest possible milk yields.

Veterinary Work. "We considered the question of expansion of the Veterinary Department, with a view to making its usefulness increasingly felt in the matter of control of contagious and other diseases. Contagious diseases have no doubt been on the decline in the last few years. We are of the opinion that there should be at least one officer in charge of veterinary matters in each district.

"Our attention has been drawn to the desirability of extending veterinary relief more in the direction of providing touring assistants than by increasing the number of veterinary hospitals or dispensaries, as the touring assistant brings relief to the very doors of the ryots. We feel that the Government should endeavour to provide one veterinary dispensary and a touring assistant for each taluk.

"We however, agree that the extension of veterinary dispensaries should be on a contributory basis. Preference should, therefore, be given to localities where the local body or the local landholder is prepared to contribute at least 30 per cent of the capital and maintenance charges.

"With this increase of staff we feel that it may not be possible for the Director of Veterinary Services to control the department effectively. We accordingly recommend that he should be given two Deputy Directors, one for the Northern Division and the other for the Southern Division.

"We also consider that in view of the importance of the work that is being done by the Veterinary Investigation Officer, the Government should consider the question of addressing the Imperial Council of Agricultural Research for the retention of that post for another five years.

"We are convinced that the work of castration, inoculation and treatment of minor ailments can be entrusted to a much cheaper agency than Veterinary Assistant Surgeons. We are also of opinion that the maistries employed by the

Agricultural Department should be utilized for this purpose. We accordingly recommend that short courses of training lasting from three to six months be introduced in select veterinary institutions where the agricultural maistry as well as sons of agriculturists and landlords may be trained.

Grazing and Fodder. "A general improvement in the condition of cattle involves the consideration of the improvement of grass and fodder supply. Similarly, the question of improvement of crops involves a consideration of the supply of green manure. We are aware that the question of grazing fees and supply of green manure from forests has often been debated It has been held by a few that the rates charged by the department at present should be reduced and brought to a uniform level. On the other hand, it has been contended with equal force that the reduction of rates will, instead, prove detrimental to the interests of the cultivator and cattle breeders. The departmental forests now serve mostly our sylvicultural needs, the panchayat forests being specially and mainly intended to serve for grazing. The departmental forests have not however, been altogether closed to grazing. A large number of animals are allowed to graze on permits from the department. We have no recommendations to make on the subject of grazing fees.

"As for the supply of green manure, we are of opinion that in the case of fuel forests where cutting is done by coupes, the coupes should be sold three months in advance of the year of cutting, the contractor being permitted during these three months to remove and sell green leaf for manure.

The forest panchayaths should be induced by reduction or remission of rent in deserving cases to grow green manure crops like wild indigo and other trees for green leaf manure.

"We understand that manure leaf plantations have already been started by the Forest Department. If the experiment turns out a success the question of starting similar plantations in Panchayat forests should be examined.

Irrigation Facilities. "No schemes for the improvement of Agriculture can be carried through without proper attention being paid to the questions of irrigation and the extension of irrigation facilities now available to the ryots. We agree with Sub-Committee II that a systematic and continuous effort should be made to carry out further drainage improvements where necessary, that drainage schemes should be considered as part and parcel of the concerned irrigation systems and that they should be sanctioned without reference to the question of direct and immediate return to Government in the shape of savings in remissions, and that no demands for contribution should be made from the interested parties.

"We also agree with the Sub-Committee that water rates under an irrigation system should be levied on a uniform basis and that extensions of irrigation should, for the purpose of working out the financial return from the scheme be considered as forming part of the original scheme. The Tank Restoration Scheme parties should be revived and the investigation and execution of the works required to improve the numerous tanks yet to be investigated should be pushed through as expeditiously as possible. We endorse the recommendations of the Sub-Committee in regard to minor irrigation works, Kudimaramat, reduction of the minimum return prescribed for productive and unproductive irrigation works, the financing of productive works from 'Loan Funds' and further investigation of the abandoned schemes of irrigation, especially the four schemes referred to by the Sub-Committee.

"We draw attention, in particular to the need for examining the question of the improvement of tanks in Malabar and South Kanara. In regard to the possibilities of extending irrigation facilities by sinking wells in river beds

we agree with the Sub-Committee that where the interests of existing irrigation are not affected, irrigation from such wells should be encouraged by Government who should charge only a nominal water rate in order to maintain their rights over the water. Further, the same procedure should be adopted when water is taken from a spring channel.

Underground Water Resources. " The question of the survey of the underground water resources was considered. The work that has so far been done is negligible. It is essential to make a thorough survey of the underground water resources of the Presidency with the aid of a geologist to be deputed by the Government of India. The services of water diviners should be requisitioned only in respect of the areas selected by the geologist. Work should be taken up in a limited area—say two or three districts, one dry and one Coast district—in the first instance and extended to the whole Presideney gradually. We also agree that further experiments should be made in the red soil areas of the Ceded Districts, these experiments being extended to other districts only if the results prove favourable.

" We agree with the view of the Sub-Committee in regard to the remission of charges incurred in sinking wells and putting down bore holes in unsuccessful cases. We approve of the recommendations of the Sub-Committee that Government should themselves sink wells and distribute water for irrigation, charging a suitable water-rate for the service rendered.

" In the interest of sugarcane cultivation in the areas covered by the Cauvery-Metur Project, we recommend that a survey be made of the underground water resources by putting down bore holes at select centres free of charge. If the results are satisfactory, *takkavi* loans should be granted to ryots for the sinking and construction of large wells. We also desire that the possibility of developing cultivation of the sugarcane crop in the area north of Kuttalam in the old Delta in Tanjore should be examined by the Agricultural Department as expeditiously as possible.

Fruit Preservation. " One of the Sub-Committees has, as already stated, considered the question relating to fruit preservation and canning, the possibility of adopting the open-pan system of sugar manufacture and the dairy industry as objects that could well be included in the scheme of agricultural development in the Presidency. We have already drawn attention to the imperative necessity for extending fruit culture in various parts of the Presidency and we have made recommendations for the employment of special staff to attend to these experiments. Fruit cultivation on any extensive scale is, however, impracticable unless a fruit preservation and canning industry is developed contemporaneously.

" We therefore, agree with the recommendations of the Sub-Committee that the Department of Agriculture should undertake research on fruit preservation on the lines recommended by it and that the Fruit Specialist should be asked to undertake research on two or three important kinds of fruit with a view to standardizing the manufacture of fruit juices and fruit syrups, bearing in mind the need for turning this industry into a cottage industry. A station for experiments on fruit preservation and canning should be attached to the research station recently opened by the Government in the Cuddapah district.

" We understand that the Government have received a report on the question of continuing the work initiated by the late Sir. F. A. Nicholson. We consider that Nicholson's work should be continued as part of the experimental work on fruits we have now recommended.

" We are of the opinion that short courses of training in fruit preservation and the preparation of juice, etc., should be provided in the Fruit Research Stations at Cuddapah and Coonoor.

Sugar Manufacture. "We agree that the open-pan method of sugar manufacture is uneconomic. As regards palmyra sugar, the proposal which, we understand, the Director of Industries has submitted for the demonstration of white sugar and improved jaggery from palmyra juice in the West Godavari District, should be favourably considered and that if the demonstration is successful, cooperative societies of tappers should be organized for this purpose, not only in West Godavari but also in Tinnevelly District.

"We agree with the conclusions of the Sub-Committee that there is no need to initiate any experiments in regard to the manufacture of sugar from the juice of coconut palm.

"As regards manufacture of activated charcoal used in decolourisation processes, we understand, that both the Departments of Agriculture and Industries have been carrying on experiments with a view to placing in the hands of the ryot an efficient and simple method of cleaning jaggery and rab by methods which will be within his means.

"The activated carbon process for preparing sugarcane products clarifies and decolorises sugarcane juice to an extent which was not possible before and enables a better quality jaggery to be prepared.

"The Department of Agriculture has successfully demonstrated the manufacture of activated charcoal from paddy husk and is at present engaged in manufacturing it from groundnut husk. The Department of Industries has, on the other hand, concentrated its attention on the manufacture of vegetable activated charcoal by processing spent tanning materials. We recommend that small-scale manufacture of activated charcoal from paddy husk, groundnut husk and spent tanning materials should be undertaken with a view to ascertaining definitely the economics of the processes employed.

Molasses. "We examined the several methods, in which molasses may be disposed of. Molasses is now being exported in tankers to Europe where it is used not only for the production of industrial alcohol and by yeast makers but also as an ingredient for cattle foods. In Mysore experiments are in progress in regard to the use of molasses as a road surfacing material. They can also be used in the boiler furnaces of sugar mills, but satisfactory furnaces which will overcome the clinkering difficulty have yet to be evolved. In India we should introduce legislation making it compulsory to mix a certain proportion of industrial alcohol with petrol but this proposal, we understand, has been turned down by the Government of India.

"Another possible way of utilising molasses produced by sugar factories situated not far from ports would be to manufacture butyl alcohol by the direct fermentation process. Butyl alcohol is becoming of increasing importance as it is widely used in the varnish and lacquer industries. By the same process acetone and ethyl alcohol are also produced whilst hydrogen and Co_2 are obtained as by-products. The possibility of attaching a factory for manufacture of these chemicals to a sugar mill located within easy distance of a port seems to be worthy of detailed examination.

"Molasses could also be usefully added to the diet of cattle. We feel that experiments should be carried on in this direction and we recommend the offer of Messrs. Parry & Co., to supply up to five tons of molasses free from their Samalkota factory for experimental purposes be accepted with thanks Molasses is also useful as manure. Experiments carried on at Allahabad seem to indicate that molasses is a useful fertilizer and reclaiming agent for alkaline soils. We recommend that the Agricultural Department initiate experiment without delay to find out the possibilities of molasses as a fertilizer.

Sugar Prices. "We view with grave anxiety the fact of Holland having gone off the gold Standard and devalued the guilder. This news has caused considerable disquiet among people interested in sugarcane growing and in sugar manufacture. Already the prices of sugar have been steadily falling for some months past, and if the fall continues, there is little doubt that the prices paid to the cultivator for cane will be seriously reduced. At this juncture particularly, a depreciated currency will increase the competitive power of Java very considerably.

"And we are of opinion that measures should be taken in time to meet the contingency of Java sugar being imported to India at cheap prices to the possible ruin of the few sugar factories that have just been started under cover of the protection afforded to the industry and incidentally of the sugarcane grower.

We accordingly by a majority passed the following resolution :—

"This Sub-Committee recommend that the Government of India be addressed to take necessary steps to counteract the effects on sugar prices of devaluation of guilder."

Agencies for Agricultural Credit. "The subject of Agricultural Credit also received our close attention. We agree that the Government agency for lending money is cheaper and speedier than any other agency, cooperative or otherwise, and approve the following Suggestions to make the cooperative agency quicker,

"(a) Introduction of the system of forecast loans. Sufficiently in advance of the cultivation season each society should prepare as carefully as possible an accurate forecast of the requirements of its members for cultivation. purchase of seed, manure. payment of kist, etc., for the whole year. The normal requirements of the society for the whole year should be arrived at and a loan application for the amount so arrived at should be sent to the Central Bank in instalment after executing the necessary bond, and make it available to members as and when there is actual need. Interest will be charged by the Central Bank on the amount drawn from time to time only. The Central Bank should remit the money to the society promptly without requiring any fresh formalities.

(b) "Supply of Agricultural implements. etc.,—Where facilities exist agricultural implements, etc., may be supplied to the ryot by debiting to the member's account through Co-operative Inspector or Agricultural demonstrator. Loans for purchase of implements, etc., need not be disbursed in cash to members. The Agricultural department ordinarily runs a depot at each taluk headquarters or at other central places. The demonstrator in charge of each depot may obtain, with the help of the supervisor of the local co-operative supervising union, an indent of the requirements of members of societies in the area and may supply the articles direct. The cost of the articles so supplied may be adjusted out of the loan sanctioned by the Central Bank to the societies. On the advice of slips issued by the demonstrator, the societies may debit the accounts of members with the cost of articles supplied to each.

(c) Joint indent system.—Similarly other requirements of members may be obtained on a joint indent system with advantage.

(d) The payment of kist loans by Central Banks into the treasury.—Loans for payment of kist need not be paid in cash. As and when instalments of kist fall due, the Central Bank on receipt of a list of kist dues of members of a society may pay the amount directly into the treasury and advise the Tahsildar and the society to make necessary entries in their respective accounts.

Crop Loans. "On the question of granting crop loans to agriculturists, we recommend " that the Departments of Agriculture and Cooperation should encourage the formation of marketing warehouses in rural areas for agricultural product and make arrangements to give crop loans to the members that

undertake to bring their crop to the said warehouses for sale by or through warehouse officers.'

In particular, we consider it necessary to adopt a system of controlled credit as a means of avoiding overdues in cooperative societies. By controlled credit we mean that the loans must be granted in instalments during the different stages of cultivation on the basis of a forecast prepared in advance, that such loans must be made on the security of crops, and that the crops so secured must be marketed by a Loan and Sale society to which the cooperative primary society must be linked. In this manner, an incentive to better cultivation can be created, the ryots can be prevented from diverting loans for other purposes, an orderly marketing of produce can be carried out to the advantage of all parties and the repayment of cooperative loans will be assured. Such experiments have been tried in Cuddalore and in Salem and have succeeded to some extent,

" The need for a Central Committee consisting of the heads of the Revenue, Cooperative, Agricultural and Industries departments, with non-officials representing Cooperation, Banking, Agricultural Interests, and Economists to plan credit work in the Agricultural Cooperative and Industries department was also examined. We are of the opinion that such Central Committee should be established. We feel, however, that the Provincial Economic Council, if enlarged by the inclusion of non officials, may serve the purpose we have in view.

" To carry out the plans formulated by the Central Committee there should be a District Committee in each district. Such a committee should consist of the local officials concerned, the President of the Cooperative Central Bank and 2 or 3 nominated non-officials. We have no objection to the District Economic Councils being utilised for this purpose.

Board of Economic Inquiry. " We also considered the need for constituting a Board of Economic Inquiry. There can be no doubt as to the need for reliable and accurate information on agriculture and economic conditions in rural areas. The present arrangement of deputing an officer of the Government to undertake any economic inquiry that is considered necessary cannot be said to work very satisfactorily. In several of the Indian Provinces, there are standing Boards of Economic Inquiry. We fully realise that already there are too many Standing Committees. The Provincial Economic Council or a Committee thereof might function as a Board of Economic Inquiry and future enquiries should be conducted under its auspices.

"To measure the effect which any plan of development has on the economic condition of the people, it is essential that we know their present income and their standard of living. We suggest :—

" That an inquiry on the subject of rural income and standard of living, should be made by the Provincial Economic Council at an early date."

Weights and Measures. " We had the benefit of a note on the subject relating to the standardization of weights and measures prepared by the Development Secretariat. In the course of the discussions it was pointed out to us that under the reformed Constitution legislation regarding standardization of weights would be a matter for the Federal Legislature. After considering the necessity for legislation, at the present juncture, in regard to weights and measures, we, have come to the conclusion that the matter might well be deferred until after the inauguration of the new constitution,

" We would, in conclusion, emphasise that the recommendations and suggestions we have made in the foregoing paragraphs will involve an appreciable expenditure of money. We are convinced that if any effective and lasting progress is to be made and the lot of the agriculturists improved and their economic condition bettered, this expenditure is inevitable.

"We know that all the schemes and proposals cannot be immediately adopted and given effect to; but the Government may, after a consideration of our suggestions, work out a programme of expansion for a period of five or ten years. It is a matter entirely for them to set forth in a systematic form their plan of expansion subject, as it will no doubt be, to financial exigencies. We regard it as important that some plan or programme should be adopted and when once adopted, that plan should as far as circumstances permit, be adhered to and carried out."

ABSTRACTS

Growing plants without Soil. Thanks to Dr. W. F. Gericke, the pioneer in plant nutrition of the University of California, growers in Los Angles and California are successfully growing vegetables and berries in nutrient solutions, heated by electricity.

Electric heating cables run under the bottom of vats. A mesh wire layer covers the top on which litter is spread to serve as seed-bed and insulation against heat-loss. The plants or seeds are placed on the bedding, and kept moist by the water in the vats. As a result of growth, the roots descend into the water when the necessary chemicals are added to the water in the right proportions. The electric cable keeps the solutions at the required temperature.

Success has been reported in the case of tomatoes, sweet-peas and strawberries. The tomatoes come to harvest earlier than 'soil grown' ones, the yield large, the quality better and hence the premium on the market price higher.

Dr. Gericke is expanding the use of this technique to the growing of tobacco, cucumbers, papaya, and other floral crops. (*Scientific American*, October 1936).

K. S. R.

The Stock Improvement Scheme in S. Rhodesia. A stock improvement scheme has recently been launched by the Government to assist stock owners to import or to improve their herds or flocks. The scheme is to be operative for the official year 1936–37 and to be limited to £ 3000 provided.

Applicants for the Government subsidies should satisfy the following conditions:

Sufficient supplementary feed must be available for the cattle and the sheep during dry weather and arrangements made to prevent heifers from breeding till the proper age is reached. The flock must be dosed regularly for internal parasites and in the case of sheep, mating to be allowed only during the breeding season. The farrowing fens for the pigs are to be provided with concrete floors.

The bull, ram, or boar selected should be approved by an officer of the department.

In the case of animals imported from the United Kingdom, the Government will contribute a sum not exceeding half the certified landed cost of the bull, limited to the maximum of £ 75, and in the case of pedigree rams or boars, limited to £ 20 per animal. The export from the United Kingdom in these cases is to be arranged through the High Commissioner for S. Rhodesia. The importer should specify that the animal is certified to be good value for the money.

In the case of animals purchased in the colony of S. Rhodesia and imported from any territory in S. Africa the Government will contribute a sum not exceeding half the certified cost of the bull or ram and boars, subject to the limit of £ 15 and £ 4 respectively. But at the discretion of the Minister of Agriculture and Lands, the contribution may be increased to £ 25 for stud bulls got in established pedigree herds. The assistance to any one breeder will be limited to 2 bulls, 2 rams or one boar during the year.

Uuder special circumstances, approved breeders may purchase pure bred female stock ; in such cases the Government contribution will not exceed half the amount granted for the respective lines.

No animal will be eligible for more than one grant during its lifetime

Breeders with animals that are likely to be useful in this scheme are required to invite the Department to inspect the same for disposal to future applicants.

No grants are paid on bulls of over eight years of age.

No animal under grants may be sold off within 12 months from the time of the grant.

The animals must be of the right age and healthy.

The home bred bulls, and rams, should be differentiated by brandings and ear-tags and the purchase is to be made as far as possible within the colony, unless suitable animals at a reasonable price are not available locally. (*The Rhodesia Agricultural Journal*, August 1936). K. S. R.

College News & Notes.

Sir John Russel, Dr. N. C. Wright, and members of the Animal Husbandry wing of the Imperial Agricultural Research Council New Delhi, visited the Agricultural College and Research Institute between the 18th and 21st instant.

Under the auspices of the Economic Biologists' Association Sir John Russel delivered an instructive lecture on the development of Scientific agriculture.

Students' Corner. The inter collegiate hockey finals was played against the Stanes High School which ended in a defeat to the college by 3 goals to nil.

The second year students retain the victory cup by defeating the first year students in both cricket and hockey in the finals.

Weather Review (NOVEMBER 1936.)

Summary of general weather conditions. A low pressure wave passed over South Peninsula causing heavy rains along its course and passed into Arabian Sea on the 3rd ; it persisted in South East Arabian Sea concentrated into a depression by the 7th and then into a cyclonic storm moving west ward and finally became unimportant off the Kathewar Coast on the 15th.

This depression caused heavy rains in the South Peninsula and later on in the western half of the Peninsula. A depression formed in the Bay on the 15th, but disappeared by the 8th after causing locally very heavy rainfall on Coramandal Coast.

The rainfall was in large excess generally in the Peninsula except in Circars. Day temparature was normal through out.
The chief falls of rain recorded were :—

Cuddalore	...	...	9·2	2nd
Panrutti	...	...	8·6	"
Virdhachalam	...	...	5·4	"
Negapatam	...	...	4·6	"
Trichinopoly	...	...	6·2	3rd
Nellore	...	...	5·0	6th
Nellore	...	...	14·1	7th

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	0·2	−3·8	80·3
	Berhampore *	1·2	−4·4	58·3
	Calingapatam	1·9	−2·0	45·2
	Vizagapatam	1·1	−2·7	36·9
	Anakapalli *	2·2	−0·7	38·9
	Samalkota*	1·7	−1·6	56·3
	Maruteru *	6·4	+2·6	55·4
	Cocanada	5·5	+0·1	68·0
	Masulipatam	4·6	−1·1	47·4
	Guntur*	4·4	+0·9	46·8
Ceded Dists.	Kurnool	0·9	−0·2	16·9
	Nandyal	3·0	+1·7	23·3
	Hagari *	6·2	+5·2	24·6
	Bellary	4·3	+2·1	17·7
	Anantapur	3·3	+0·5	17·4
	Rentachintala	4·1	...	22·5
	Cuddapah	6·5	+2·92	21·1
	Anantharajupet *	13·2	...	...
Carnatic	Nellore	30·1	+18·9	49·4
	Madras	14·5	+0·2	42·3
	Palur *	19·6	+9·2	43·7
	Tindivanam *	12·3	+2·5	29·6
	Cuddalore	21·7	+6·6	42·5
Central	Vellore	12·7	+5·8	31·9
	Salem	3·1	−0·6	31·6
	Coimbatore	3·9	+0·1	21·3
	Coimbatore Res. Inst. *	4·4	−0·1	20·0
	Trichinopoly	13·7	+8·1	30·1

Division	Station	Actual for month	Departure from normal @	Total since January 1st
South	Negapatam	12·9	−4·8	32·9
	Aduthurai *	12·8	+3·0	33·1
	Madura	7·6	+2·6	28·5
	Pamban	14·3	+2·3	28·4
	Koilpatti *	7·6	+0·7	22·5
	Palamkottah	8·6	+1·2	26·9
West Coast	Trivandrum	11·6	+5·0	70·3
	Cochin	8·6	+2·1	115·1
	Calicut	7·8	+2·4	134·9
	Pattambi *	7·2	+3·6	118·0
	Taliparamba *	8·1	+3·6	130·7
	Kasargode *	5·3	−0·8	155·0
	Nileshwar *	4·3	+1·0	138·3
	Mangalore	2·7	−0·4	161·9
Mysore and Coorg	Chitaldrug	4·7	+2·4	20·1
	Bangalore	2·0	−0·9	30·3
	Mysore	2·3	−0·2	36·7
	Mercara	1·7	−1·5	151·5
Hills.	Kodaikanal	22·8	+14·6	70·3
	Coonoor*	13·0	...	69·3
	Ootacamund *	6·3	+1·7	54·6
	Nanjanad *	2·8	−1·0	52·2

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 (published in Fort St. George Gazette).

Weather Report for the Research Institute Observatory :—

Report No. 11/36.

Absolute Maximum in shade	...	...	87·0°F.
Absolute Minimum in shade	...	...	60·0°F.
Mean Maximum in shade	...	...	83·9°F.
Departure from normal	...	...	−0·8.
Mean Minimum in shade	...	...	69·0°F.
Departure from normal	...	...	+0·3.
Total rainfall ...	...	...	4·43"
Departure from normal	...	...	−0·10"
Heaviest fall in 24 hours	...	...	1·33"
Total number of rainy days	...	...	8 days.
Mean daily wind velocity	...	...	1·2 M. P. H.
Mean Humidity at 8 hours	...	...	84·0%
Departure from normal	...	...	+2·7%

Summary. The monsoon was fairly active during the month giving normal rainfall. Day temperature and humidity remained normal.

Departmental Notifications.

Transfers and Postings. Mr. C. S. Rajaratnam Mudaliar, A. A. D., Mycology, Koilpatty, to be A. D, Mycology, Coimbatore; Mr. C. Rangaswamy Ayyangar, A. D., Mycology, Coimbatore, to be A. D., Mycology, Koilpatty; Mr. M. K. Swaminatha Iyer, A. D., Arkonam, to be F. M., Central Farm; Mr. V. Achyutaramiah, D. A. S., Anakapalle, to be A. D., II Circle: Mr. V. N. Subbana Acharya, D. A. S., Bellary, to be A. D., Guntakal; Mr. P. Nagadhara Naidu, A. A. D., Guntakal, to be A. A. D., Adoni; Mr. S. Varadharajulu Naidu, A. D., Adoni, to be A. D, Allagadda; Mr. A. Anantapadmanabha Pillai, A. D., Allagadda, to be A. D., Nandyal; Mr. M. Chinnaswamy Naidu, A. D., Special Duty, to be A. D., Udamalpet; Mr. A. K. R. Iyer, A. D., Udamalpet, to be A. D., Gobi; Mr. K. C. Thomas, A. D., Gobi, to be A. D., Tirupur; Mr. N. Srinivasa Rao, A. D., Tirupur, to be A. D., Pollachi; Mr. B. G. N. Menon, A. D., Pollachi to work under A. D., Coimbatore; Mr. C. Vadamalai, Assistant in the Cotton Section to be F. M., Hagari; Mr. K. Tejappa Shetty, F. M., Hagari to report himself to D. D. A., VII Circle; Mr. B. Dasappa Malli, A. D, Coonoor to be A. D., Puthur; Mr. S. Madhava Rao, F. M., Anantharajapet to be F. M., Botanical Gardens, Coimbatore; Mr. R. Sankara Iyer is permitted to return to duty cancelling the unexpired portion of the leave. Mr. K. Ramanuja Acharya, Special Duty under the Live Stock Officer to report himself to D. D. A., II Circle.

Leave. Mr. A. P. Balakrishnan Nair, F. M., Kasargod, l. a. p. for one month and one day from 22—11—'36 with permission to suffix the Xmas and New Year holidays; Mr. T. Gopalan Nair, F. M., Nileshwar II, l. a. p. for two months from 4—1—'37 with permission to prefix the Xmas and New Year holidays.

Concession for old unemployed students of the Agricultural College, Coimbatore.

Old boys (unemployed only) of the Agricultural College, Coimbatore may apply to the undersigned for a concession in subscription from 1937. They will be charged Rs. 2/- only per annum, provided a certificate to the effect that they are without job is attached to the concession application. This rate will hold good till they continue to be unemployed.

Manager